Middlesex County, New Jersey
Multi-Jurisdictional Hazard Mitigation Plan

prepared by:

Middlesex County
Office of Emergency Management

October 21, 2010

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Executive Summary

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2.1 Overview

On October 30, 2000, the President signed into law the Disaster Mitigation Act of 2000, also known as DMA 2000. Among its other features, DMA 2000 established a requirement that in order to remain eligible for federal disaster assistance and grant funds, local and state governments must develop and adopt hazard mitigation plans (HMPs). On February 26, 2002, the Federal Emergency Management Agency (FEMA) published an Interim Final Rule (IFR) that set forth the guidance and regulations under which such plans are supposed to be developed. The IFR provides detailed descriptions of both the planning process that States and localities are required to observe and the contents of the plan that emerges. This document, the Middlesex County New Jersey Multi-Jurisdictional Hazard Mitigation Plan (the Plan) responds to those requirements.

Hazard mitigation is often defined as actions taken to reduce the effects of natural hazards on a place and its population. Middlesex County decided to develop the Plan because of increasing awareness that natural hazards, especially flood and wind, have the potential to affect people, physical assets and operations in Middlesex County.

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The purpose of a mitigation plan is to rationalize the process of determining appropriate hazard mitigation actions. The document includes a detailed characterization of natural hazards in Middlesex County; a risk assessment that describes potential losses to physical assets, people and operations; a set of goals, objectives, strategies and actions that will guide Middlesex County mitigation activities, and a detailed plan for implementing and monitoring the Plan.

This Plan focuses on six hazards with the highest potential for damaging physical assets, people and operations in Middlesex County. These hazards are: floods, high wind – straight-line winds, severe storm – winter weather, earthquake/geological, hazardous materials release – fixed site and hazardous materials release – transportation. Both the risk assessment and mitigation action plan sections reflect this emphasis, which was the result of careful consideration and a numerical ranking process carried out by the Middlesex County Hazard Mitigation Steering Committee (HMSC).

2.2 Organization of the Plan

The Plan is organized to parallel the structure provided in the IFR. The Plan has ten sections.

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There are references to the IFR throughout the Plan. Where possible these provide specific section and subsection notations to aid the review process. The Plan also includes references to the FEMA crosswalk document, which is used in reviewing mitigation plans.

2.3 Hazards and Risks

2.3.1 Hazards

Sections 6 and 7 of this Plan include detailed descriptions of the process that was used to assess and prioritize Middlesex County risks from natural hazards, quantitative risk assessments for Middlesex County as a whole, and more detailed assessments for certain asset classes. Eighteen hazards were initially identified and profiled by the HMSC. These are:

- Dam Failure
- Drought
- Earthquake / Geological
- Erosion – Hurricane / Nor'easter / Coastal Storm
- Extreme Temperature – Cold
- Extreme Temperature – Heat
- Flood
- Hail
- Hazardous Materials Release – Fixed Site
- Hazardous Materials Release – Transportation
- High Wind – Straight-line Winds
- High Wind – Tornado
- Ice Storm
- Landslide (non-seismic)
- Severe Storm - Lightning
- Severe Storm – Winter Weather
- Storm Surge – Hurricane / Nor'easter / Coastal Storm
- Wildfire

For each of these hazards, the profiles in Section 6 include:

- Description
- Geographical Extent
- Severity
- Impact on Life and Property
- Occurrence (probability)

After these initial 18 hazards were profiled, the HMSC used an evaluation system with five criteria to reduce the range of hazards to those with the most potential to impact Middlesex County. The ranking and criteria are also discussed in detail in Section 6. The criteria included: (1) History, (2) Potential for mitigation, (3) Presence of susceptible areas, (4) Data availability, (5) Federal disaster declarations and local emergency declarations.

As a result of this evaluation, the HMSC determined that seven hazards present the greatest risk to Middlesex County and its residents; floods, straight-line winds, winter weather, earthquake/geological, hazardous materials release from fixed sites and transportation, and tornadoes. These hazards were further examined to determine the extent of the risk and to start to identify potential projects.

2.3.2 Risks

A risk calculation is a FEMA requirement. Risk is a numerical indication of potential future damages. Although the range of events from winter weather to hurricanes all have some potential to affect the Middlesex County area, are clearly the most significant hazards, based on the ranking criteria and experience. These six hazards were selected for much more detailed assessments and estimations of future damages. Section 7 includes details about calculation methodologies and results of the risk assessment, which are summarized in Table 2.3.2-1. For a more detailed explanation and discussion on risk assessment and the results represented in this table, refer to Section 7.6, Summary of Risk Assessment.

Table 2.3.2-1:
Summary of Middlesex County's Natural Hazard Risks

Hazard	Asset	Risk (100-year horizon)	Risk Per SF	Risk Per Capita
Flood	Repetitive loss properties (residential)	$7,758,185	$20.30	$16,248
Flood	Severe Repetitive loss properties	$356,366	$29.69	$23,757
Flood	Deaths and Injuries	Not Determined	NA	NA
High Wind - Straight-line Winds	All Assets	$677,027,821	$1.81	$462
High Wind - Straight-line Winds	Deaths and Injuries	Not Determined	NA	NA
Severe Storm - Winter Weather	All assets, direct damages (3)	$20,856,147	NA	$14
Severe Storm - Winter Weather	Deaths (monetized) (4)	$3,253,560	NA	NA
Severe Storm - Winter Weather	Injuries (monetized)	$856,200	NA	NA
Earthquake / Geological	All Assets	$79,530,640	$0.21	$54
Earthquake / Geological	Deaths (monetized)	$140,452,376	NA	NA
Earthquake / Geological	Injuries (monetized)	3,726,107	NA	NA
Hazardous Materials Release (fixed sites and transportation)	All assets, direct damages	See Section 7.3.5	NA	NA
Dam Failure	All assets, direct damages	See Section 7.3.6	NA	NA

2.4 Goals, Objectives and Actions

Section 9 of this Plan describes Middlesex County priorities for mitigation actions. The section divides the actions by priority, and describes the funding required, sources of funding, the level of support and the timing of the action. The section also includes Middlesex County hazard mitigation goals and objectives.

2.4.1 Middlesex County Hazard Mitigation Goals

Goals are general guidelines that explain what Middlesex County wants to achieve. Goals are expressed as broad policy statements representing desired long-term results. Middlesex County mitigation planning goals include:

1. Improve education and outreach efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact
2. Improve data collection, use and sharing to reduce the impacts of hazards
3. Improve capabilities, coordination and opportunities at municipal and county levels to plan and implement hazard mitigation projects, programs and activities
4. Pursue opportunities to mitigate repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs and activities

2.4.2 Objectives

Objectives are well-defined intermediate points in the process of achieving goals. ("Objectives" are generally coterminous with "strategies.") Middlesex County mitigation planning objectives include:

- Increase awareness of risks and understanding of the advantages of mitigation by the general public and by local government officials
- Increase local government official awareness regarding funding opportunities for mitigation
- Improve data available to the county and participating communities for use in future planning efforts
- Provide government officials and local practitioners with educational opportunities and information regarding best practices for hazard mitigation planning, project identification and implementation
- Continue support of hazard mitigation planning, project identification and implementation at the municipal and county level
- Support increased participation in the National Flood Insurance Program Community Rating System (NFIP/CRS)
- Support increased integration of municipal/county hazard mitigation planning and floodplain management with effective municipal/county zoning regulation, subdivision regulation, and comprehensive planning
- Elicit and support efforts by federal and state legislatures and agencies to address shortcomings in existing laws, programs and administrative rules related to hazard mitigation
- Facilitate development and timely submittal of project applications meeting state and federal guidelines for funding for repetitive and severe repetitive loss properties and hardening / retrofitting infrastructure and critical facilities with highest vulnerability rankings
- Maintain and enhance local regulatory standards including full and effective building code enforcement, floodplain management, and other vulnerability-reducing regulations.

2.4.3 Actions

Action Items are the specific steps (projects, policies, and programs) that advance a given Objective. They are highly focused, specific and measurable. Middlesex County mitigation actions include:

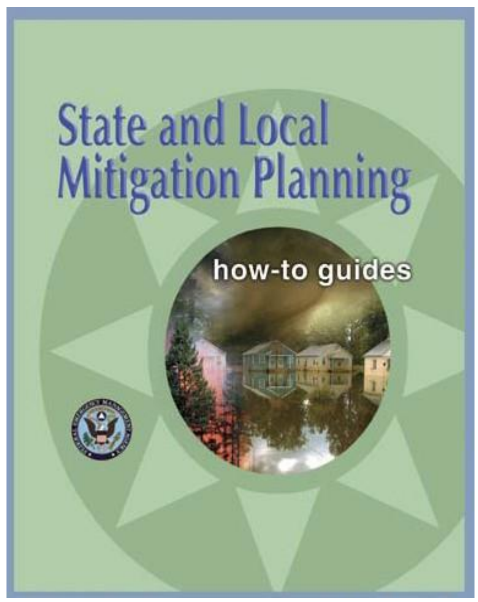
- Acquisitions of floodprone properties in Old Bridge Township
- Flood proofing electric systems at apartment complexes in Piscataway Township
- Community outreach programs in Dunellen Borough
- Structural retrofits of floodprone critical infrastructure in the City of South Amboy
- Storm sewer infrastructure improvements in Jamesburg Borough
- Engineering studies to improve drainage problems in the City of New Brunswick
- Generator installation in a Metuchen Borough fire department.
- Warning system installation in Highland Park Borough

2.5 Planning Process

Section 5 provides details about the process that was used to develop this Plan. The process closely followed the guidance in the FEMA "386" series of planning guidance, which recommend a four-stage process for developing mitigation plans.

- Step 1 Organize resources
- Step 2 Assess risks
- Step 3 Develop a mitigation plan
- Step 4 Implement the plan and monitor progress

Step 1, organizing resources, is described in Section 5 (Planning Process). The section includes details about who was involved, the processes that were used to establish leadership and advisory groups, and public and other outreach and involvement efforts.



Step 2, the risk assessment, was completed by the HMSC. The Risk Assessment is included as Section 7 of the Plan, and is preceded by a separate Hazard Identification in Section 6.

Step 3, development of the Mitigation Plan is described in Section 5 (Planning Process) and Section 9 (Mitigation Action Plan). Section 5 includes details about who was involved, the processes that were used, and the products that were developed. Section 9 includes specific details about the identification and development of mitigation goals, objectives and actions based upon Section 7 (Risk Assessment) and Section 8 (Capability Assessment).

Step 4, implementing the Plan, is described in the Mitigation Action Plan in Section 9, which includes details about who is responsible for implementation of specific strategies and actions; and in Section 10, the Plan Monitoring and Maintenance section, which describes long-term implementation through periodic updates and reviews.

2.6 Adoption and Approval

The Middlesex County Office of Emergency Management (MCOEM), with the endorsement of the HMSC, was responsible for recommending plan approval to The Middlesex County Board of Chosen Freeholders. Consistent with that recommendation, the Middlesex County Board of Chosen Freeholders adopted this Hazard Mitigation Plan on October 21, 2010. Following adoption, the Plan was submitted to FEMA Region II. FEMA reviewed and approved the Plan on October 4, 2010. Subsequently, the participating municipalities also adopted the Plan, submitted their adoption resolutions to FEMA and received their own approval notifications (see Appendices H and I).

The following 25 municipalities participated in the Plan along with Middlesex County by taking an active part in the planning process, identifying mitigation actions, and will adopt the plan:

- Carteret Borough
- Cranbury Township
- Dunellen Borough
- East Brunswick Township
- Edison Township
- Helmetta Borough
- Highland Park Boro
- Jamesburg Borough
- Old Bridge Township
- Metuchen Borough
- Middlesex Borough
- Middlesex County
- Milltown Borough
- Monroe Township
- New Brunswick City
- North Brunswick City
- Perth Amboy City
- Piscataway Township
- Plainsboro Township
- Sayreville Borough
- South Amboy City
- South Brunswick Township
- South Plainfield Borough
- South River Borough
- Spotswood Borough
- Woodbridge Township

It is important to note that this represents 100% participation by municipalities in Middlesex County.

To determine if municipal participation in the planning process was adequate for the purposes of this Plan and the FEMA plan review process, the following were established as minimum criteria

1. Attendance by a representative of each municipality at two (2) meetings where the development of the Plan was discussed;
2. Completion of portions of the capability assessment survey regarding the identity and participation of floodplain administrators, and the current status and update intervals for master plans, zoning plans and capital improvement plans;
3. Identification and documentation of at least two (2) mitigation actions for identified hazards; and

4. Adoption of the Plan after designation of the Plan as "approvable pending adoption" is received from NJOEM and FEMA.

2.7 Implementation

The implementation process is described as part of the specific actions in the Mitigation Action Plan in Section 9.

2.8 Monitoring and Updating the Plan

Section 10 (Plan Monitoring and Maintenance) describes the schedule and procedures for ensuring that the Plan stays current. The section identifies when the Plan must be updated, who is responsible for monitoring the Plan and ensuring that the update procedures are implemented. This section provides a combination of cyclical dates (oriented toward FEMA requirements) and triggering events that will initiate amendments and updates to the Plan. MCOEM is responsible for monitoring the Plan and initiating the cyclical update process. The MCOEM point of contact is:

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Section 3
Context

Contents of this Section

3.1 Introduction

The recommendations in the Middlesex County Multi-Jurisdictional Hazard Mitigation Plan (the Plan) are based in large part on identification of past and potential problems due to natural and man-made hazards. As part of the process of identifying potential problems, it is useful to understand the physical characteristics of the county. It is also important to understand any related planning efforts by the New Jersey Office of Emergency Management (NJOEM) as well as requirements of the federal government regarding hazard mitigation plans. In addition, this section provides definitions for key terms used throughout the Plan.

3.2 Geography, Climate and Population of Middlesex County

3.2.1 Geography

Middlesex County is located in the center of New Jersey and is bisected by the Raritan River. The county is topographically consistent with other central New Jersey counties. Middlesex County is mostly flat, with the highest point approximately 300 feet above sea level. Middlesex County falls between Union County to the north, Monmouth County to the southeast, Mercer County to the southwest, Somerset County to the northwest and Richmond County, NY to the northeast.[1] The county is 318 square miles in size, has 25 municipalities and includes extensive industrial, office, and residential areas. As one of the fastest growing counties in New Jersey, Middlesex County also operates 18 county parks encompassing 6,600 acres and through an Open Space Trust Fund is helping to preserve 3,400 acres of active farmland in the Garden State.[2]

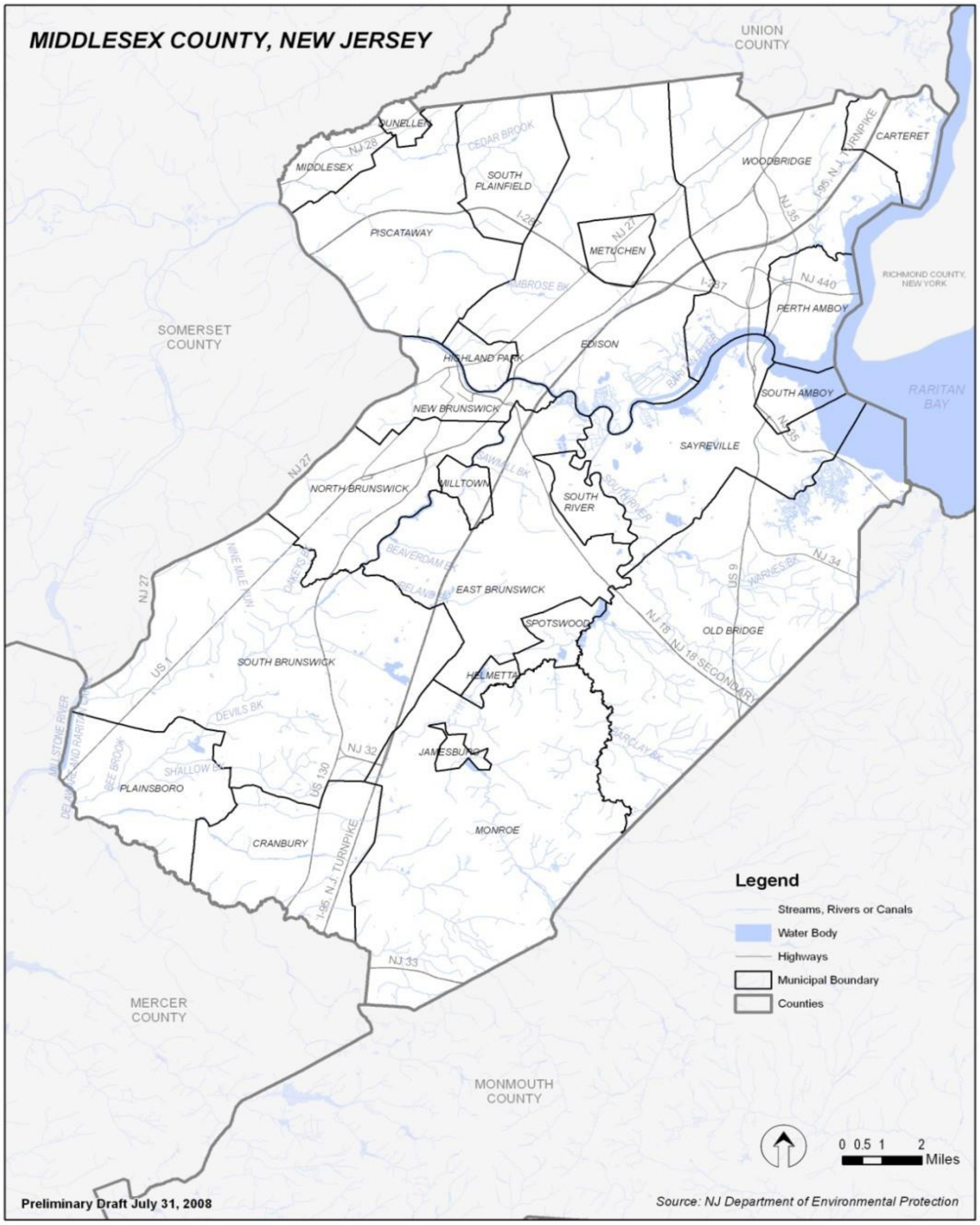
Major roadways that traverse Middlesex County include the New Jersey Turnpike (NJT), Garden State Parkway (GSP), Interstate 287, US Routes 1, 9,130 and State Route18. In addition, NJ Transit buses and trains and Amtrak trains all serve as modes of passenger transportation in Middlesex County.

[1] State and County QuickFacts." U.S. Census of Bureau. U.S. Department of Commerce. 15 May 2008. <http://quickfacts.census.gov/qfd/maps/new_jersey_map.html>.

[2] "About Middlesex County." Middlesex County. Middlesex County. 20 May 2008 <http://www.co.middlesex.nj.us/profile.asp>.

Middlesex County is home to several freight rail corridors, such as Chemical Coast line, which traverses the county south-north and the Perth Amboy Running track, which is an east-west corridor. Most freight rail lines in Middlesex County are operated by Conrail Shared Assets Operations (CSAO).[3]

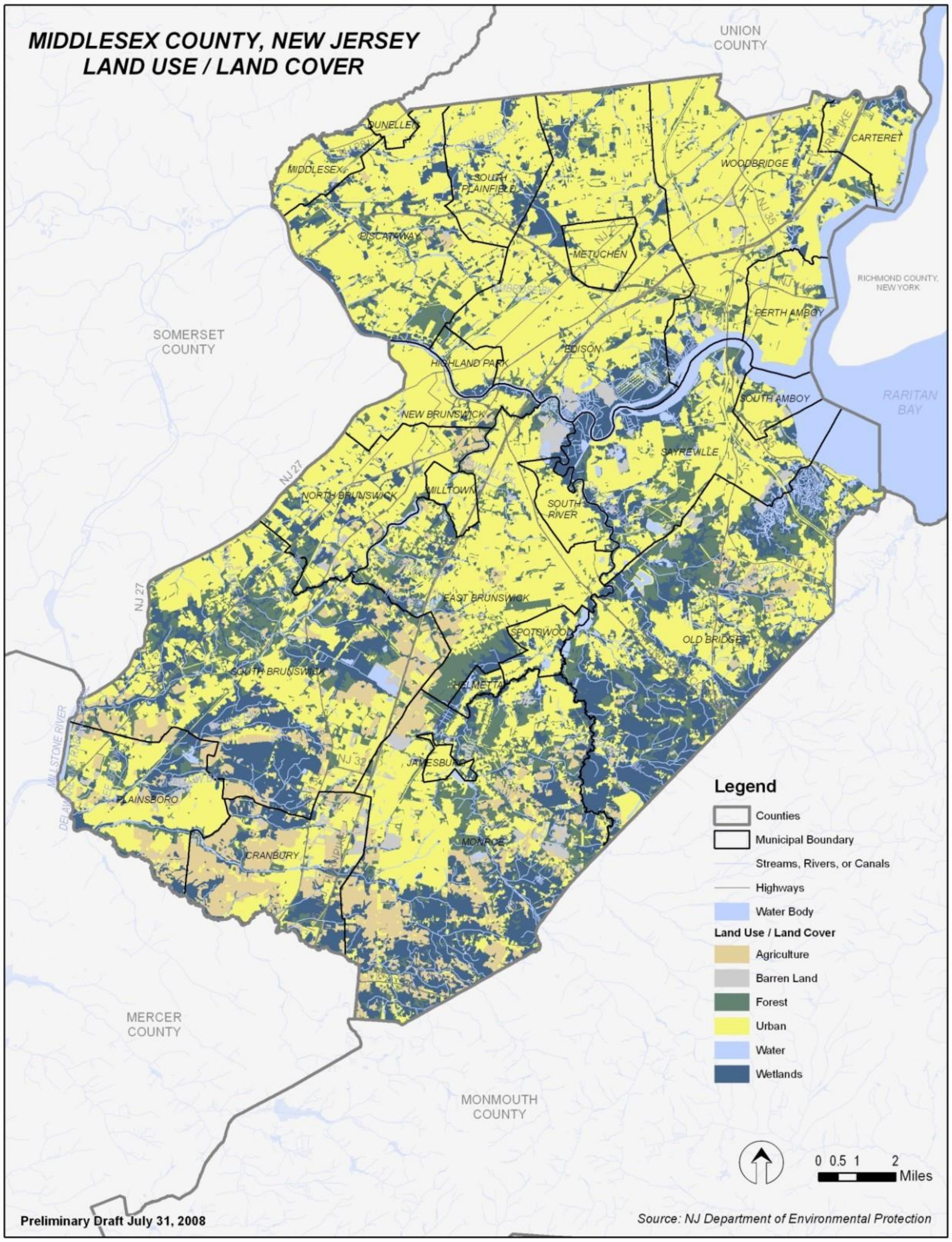
Figure 3.2.1-1
Middlesex County Map



[3] http://www.state.nj.us/transportation/gis/maps/railroads.pdf

As shown in Figure 3.2.1-2, land use in the county is primarily urban; 52.34 percent is considered as developed. Other prevalent land use types are agriculture (6.95 percent) wetlands (20.27 percent) and forest (13.6 percent).

Figure 3.2.1-2
Land Use/Land Cover in Middlesex County Map



3.2.2 Climate

Middlesex County enjoys an average of 206 sunny days per year with a high around 85°F in the month of July and an average low of 21°F in the month of January.[4] The temperature is rarely below zero or above 100 F. Precipitation is evenly distributed through the year. Middlesex County receives on average 48.78 inches of rain a year and 30 inches of snow per year[5]. Spring and summer frontal storm systems can produce high rainfall amounts and spawn tornadoes. Tropical storm systems can affect the northern Atlantic seaboard from late summer to late fall.

3.2.3 Population

The population of Middlesex County has steadily increased in recent years. As shown in Table 3.2.3-1, the population has increased at an annual rate of slightly more than 1%.

Table 3.2.3-1:
United States Census – Middlesex County, New Jersey Population
(Source: 2006 Census: American Fact Finder)

	1990	2000	2006
Population	**671,780**	**750,162**	**786,971**

Building and development permit activity over the last few years (see Table 3-2) reflects these increases as single-family residential permits have been issued at an average rate of over 200 per year.

Table 3.2.3-2:
Middlesex County Buildings Permits and Development Permits
(Source: Middlesex County Planning Department)

Development Review Type	2005	2006	2007
Single Family	245	214	192
Multi Family	59	50	65
Commercial	115	132	101
Office	48	48	41
Industrial	79	58	66
Public/Quasi-Public	61	107	46
Land Use Totals	607	609	511

A breakdown of the population of Middlesex County as collected by the US Census is compiled in the Table 3.2.3-3 on the following page:

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[4] "About Middlesex County." Middlesex County. 5 August 2008 http://www.co.middlesex.nj.us/facts.asp.
[5] "Middlesex, New Jersey Detailed Profile." City-Data.Com. 21 May 2008 <http://www.city-data.com/city/Middlesex-New-Jersey.html>.

Table 3.2.3-3:
U.S. Census Population Characteristics for Middlesex County, New Jersey, 2006
(Source: 2006 Census: American Fact Finder)

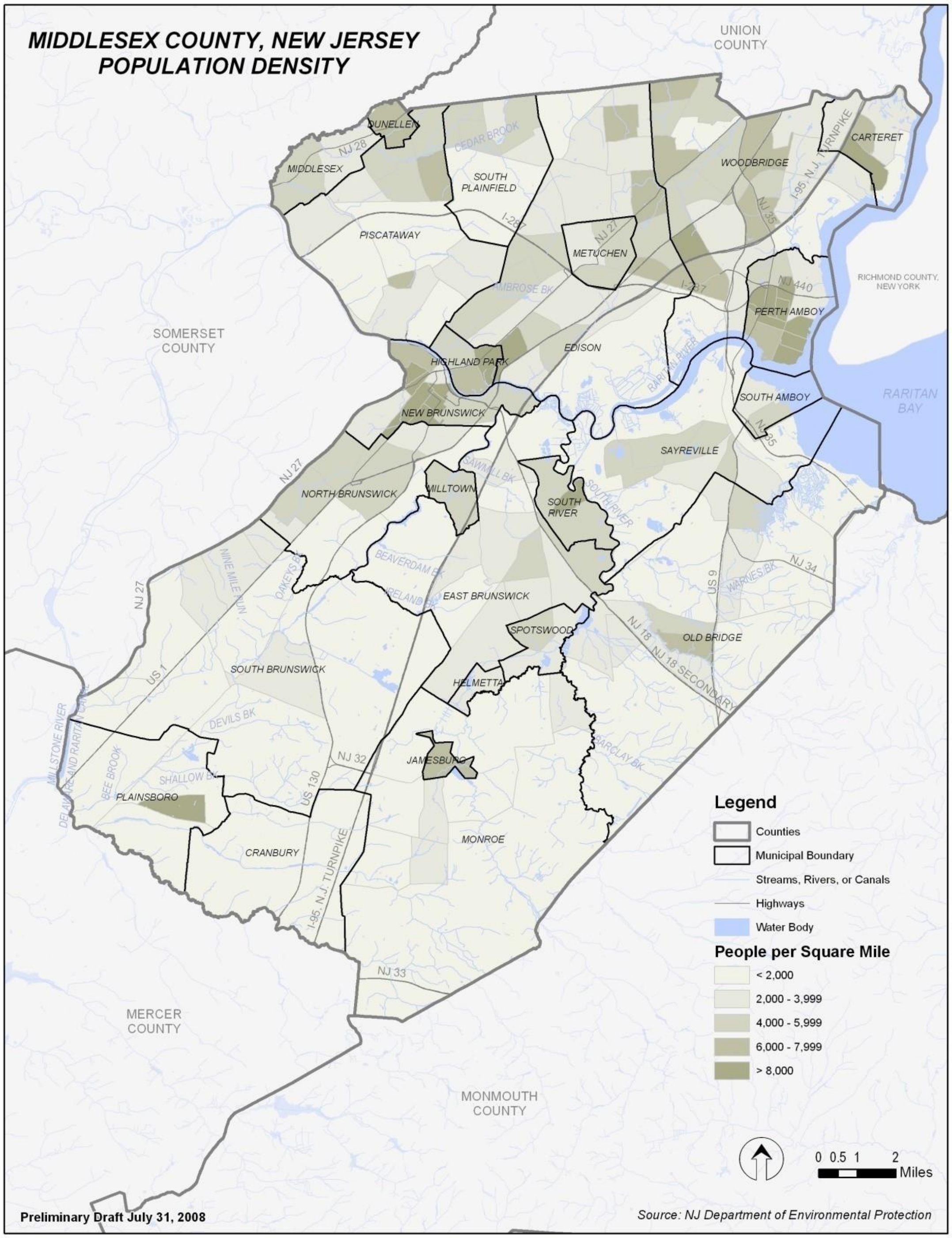
General Characteristics	Middlesex	NJ	U.S.
Total population	786,971	5,871,240	299,398,485
Male (%)	49.4%	48.8%	49.2%
Female (%)	50.6%	51.2%	50.8%
Median age	36.9	38.2	36.4
Under 5 years (%)	6.6%	6.4%	6.8%
18 years and over (%)	76.6%	76.0%	75.4%
65 years and over (%)	12.0%	12.9%	12.4%
Housing Characteristics	**Middlesex**	**NJ**	**U.S.**
Total housing units	285,527	3,472,782	126,311,823
Occupied housing units (%)	94.7%	90.3%	88.4%
Owner-occupied housing units (%)	63.6%	67.3%	67.3%
Renter-occupied housing units (%)	31.0%	32.7%	32.7%
Vacant housing units (%)	5.3%	9.7%	11.6%
Social Characteristics	**Middlesex**	**NJ**	**U.S.**
High school graduate or higher (population 25 years and over)	86.5%	86.1%	84.1%
Bachelor's degree or higher (population 25 years and over)	37.4%	33.4%	27.0%
Disability status (population 5 years and over)	9.8%	12.3%	15.1%
Foreign born	28.2%	20.1%	12.5%
Economic Characteristics	**Middlesex**	**NJ**	**U.S.**
In labor force (population 16 years and older)	67.1%	66.2%	65.0%
Median household income	$72,669	$64,470	$48,451

There are a few notable differences between Middlesex County, the rest of New Jersey and the US as a whole. There is a slightly higher occupancy rate for all housing units but lower owner-occupied housing in Middlesex County as compared to the State and the rest of the country.

The most significant difference is in terms of median household income where Middlesex County residents earn 13% and 50% more than the average households in New Jersey and the US respectively.

Population density is high in Middlesex County; 2419.9 people per square mile on average, which is 213% higher than the average for New Jersey (1,134.5 people/sq. mi.) and nearly 3,000% higher than the national average (80.7 people/sq. mi). Figure 3.2.3-1 on the following page shows the distribution of the county population.

Figure 3.2.3-1
Population Density by Census Tract, Middlesex County Map



3.2.4 Special Consideration Communities

Although the county as a whole has higher income levels than the national average, it is still important to determine if any municipalities within the county would qualify as "special consideration communities." Special Consideration Communities are often eligible for grants for hazard mitigation and other community improvements on a preferential basis or with less stringent requirements for the required non-federal share portion of the grant.

The federal government defines a special consideration community as one with 3,000 or fewer individuals that is a rural community, and is not a remote area within the corporate boundaries of a larger community. Such communities are economically disadvantaged, with residents having an average per capita annual income not exceeding 80% of the national per capita income based on best available data (e.g., National Per Capita Income for 2000, in 1999 dollars, was reported to be $26,535). Further, special consideration communities have a local unemployment rate that exceeds by one percentage point or more, the most recently reported average national unemployment rate.

Two communities in Middlesex County can meet the population limitation; with population values of 1,835 and 2,180, but are not likely candidates as they are part of the New York-Northern New Jersey-Long Island, NY-NJ-PA Metro Area and would not be considered "rural communities." Furthermore, both have higher per capita incomes than the stated threshold. Three Middlesex County communities have lower per capita incomes than the threshold but have relatively large populations (all have 2000 census populations of greater than 20,000 residents) and would also be considered urban areas. While these communities do not qualify for the federal definition, these circumstances are considerations for implementation strategies for these communities.[6]

3.3 The New Jersey State Hazard Mitigation Plan

On April 28, 2008 NJOEM received approval from FEMA for an update of the New Jersey State Hazard Mitigation Plan (SHMP)[7]. NJOEM describes the plan and its purpose as follows:

"The purpose of the State Hazard Mitigation Plan is to rationalize the process of identifying and implementing appropriate hazard mitigation actions. … The present plan update document [2008] constitutes a comprehensive re-write of the original 2005 document. … "

"The development of State and local multi-hazard mitigation plans is key to maintaining eligibility for future PDM funding for:

- Property acquisition or relocation of hazard prone property for conversion to open space in perpetuity;
- Structural and non-structural retrofitting … ;
- Minor structural hazard control or protection projects … and,
- Localized flood control projects, such as certain ring levees and floodwall systems, ..."

"The document includes:

- Characterization of natural hazards Statewide, including occurrences, impacts and probability
- Vulnerability assessment and loss estimation
- Identification of jurisdictions most at risk
- Goals, objectives, strategies and actions that will guide the State's mitigation activities
- A comprehensive evaluation of progress towards achieving the original 2004 goals, strategies and actions
- A process for implementing and monitoring the Plan"

[6] US Census Bureau. Census 2000. Available at http://www.census.gov
[7] http://www.state.nj.us/njoem/mitigation-plan08.html

"The State provides assistance and guidance to local jurisdictions for developing their hazard mitigation Plans. … Information from the State and local Plans is linked and integrated, and … the State prioritizes funding opportunities for local jurisdictions."

Wherever possible, the Plan has incorporated information and recommendations consistent with the New Jersey State Hazard Mitigation Plan Update.

3.4 Federal Planning Requirements

According to the federal rules describing the Disaster Mitigation Act of 2000 (FR 8848, Feb. 26, 2002, as amended at 67 FR 61515, Oct. 1, 2002), "The local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards." Local plans serve "as a guide for decision makers as they commit resources to reducing the effects of natural hazards. Local plans will also serve as the basis for the State to provide technical assistance and to prioritize project funding."

Relevant federal planning requirements include establishing minimum standards for grant program eligibility and outlining a planning process.

3.4.1 Grant Program Eligibility

The various federal mitigation grant programs and their planning requirements are listed below:

Hazard Mitigation Grant Program (HMGP)

According to 44 CFR §201.3, " For disasters declared after November 1, 2004, a local government must have a mitigation plan approved pursuant to this section in order to receive HMGP project grants."

Pre-Disaster Mitigation (PDM)

According to 44 CFR §203, " By November 1, 2003, local governments must have a mitigation plan approved pursuant to this section in order to receive a project grant through the Pre-Disaster Mitigation (PDM) program, authorized under Sec. 203 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5133. PDM planning grants will continue to be made available to all local governments after this time to enable them to meet the requirements of this section."

Flood Mitigation Assistance (FMA)

According to 44 CFR §78.4, " To be eligible for Project Grants, an eligible applicant will develop, and have approved by the FEMA Regional Director, a Flood Mitigation Plan in accordance with §78.5."

Severe Repetitive Loss (SRL)

According to the 2008 SRL guidance, "all sub-applicants must have a FEMA-approved hazard mitigation plan by the application deadline to be eligible to receive project grant funding under the SRL program."

Public Assistance (PA)

State and local governments are eligible to receive assistance in the “emergency” categories of the PA program (Categories A and B). However, an approved State hazard mitigation plan is required for any applicant, State or local, to be eligible to obtain funding assistance for any categories of “permanent work” under the FEMA Public Assistance Program [Categories C through G].

According to 44 CFR §206.226, “ In order to receive assistance under this section, as of November 1, 2004 (subject to 44 CFR 201.4(a)(2)), the State must have in place a FEMA approved State Mitigation Plan in accordance with 44 CFR part 201.”

3.4.2 Planning Process Requirements

The following excerpts from the IFR outline the required planning process. The process used to develop this Plan for Middlesex County is consistent with these requirements.

“Multi-jurisdictional plans may be accepted, as long as each jurisdiction has participated in the process and has officially adopted the plan. State-wide plans will not be accepted as multi-jurisdictional plans.”

“In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies, … businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.”

“The plan shall include the following:

(1) Documentation of the *planning process* [see Section 5 of this Middlesex County Plan, plus appendices] used to develop the plan.
(2) A *risk assessment* [see Sections 6 and 7 of this Middlesex County Plan, plus appendices] that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. … The risk assessment shall include:
    (i) A description of the type, location, and extent of all natural hazards that can affect the jurisdiction. …
    (ii) A description of the jurisdiction’s vulnerability to the hazards described. …
    (iii) For multi-jurisdictional plans, the risk assessment section must assess each jurisdiction’s risks where they vary from the risks facing the entire planning area.
(3) *A mitigation strategy* [see Section 9 of this Middlesex County Plan, plus appendices] that provides the jurisdiction’s blueprint for reducing the potential losses identified in the risk assessment. … This section shall include:
    (i) A description of mitigation goals.
    (ii) A section that identifies and analyzes a comprehensive range of specific mitigation actions and projects.
    (iii) An action plan describing how the actions … will be prioritized, implemented, and administered by the local jurisdiction.
    (iv) For multi-jurisdictional plans, there must be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.

(4) A *plan maintenance process* [see Section 10 of this Middlesex County Plan, plus appendices] that includes:
   (i) A section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
   (ii) A process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms …
   (iii) Discussion on how the community will continue public participation in the plan maintenance process.

(5) *Documentation* [see Section 4 of this Middlesex County Plan, plus appendices] that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan … For multi-jurisdictional plans, each jurisdiction requesting approval of the plan must document that it has been formally adopted.

The Plan further details and explicates federal requirements for each section or element by quoting the requirements in their entirely at the start of each relevant section.

The federal requirements continue, "Plans must be submitted to the State Hazard Mitigation Officer for initial review and coordination. The State will then send the plan to [the FEMA Region II office] for formal review and approval. The Regional review will be completed within 45 days after receipt from the State, whenever possible.

"Plans must be reviewed, revised if appropriate, and resubmitted for approval within five years in order to continue to be eligible for HMGP project grant funding."

3.5 Key Terms

100-Year Flood: The flood event that has a 1% chance of being equaled or exceeded each year (see also BFE, SFHA). Thus, the 100-year flood could occur more than once in a relatively short period of time. The 100-year flood, which is the standard used by most Federal and state agencies, is used by the National Flood Insurance Program (NFIP) as the standard for floodplain management and to determine the need for flood insurance.

500-Year Flood: The flood event that has a .02% chance of being equaled or exceeded each year.

Base Flood Elevation (BFE): The height at which there is a 1 percent change or greater of flooding in a given year (see also 100-year flood, SFHA). The BFE is used for flood insurance policy rating. An Advisory Base Flood Elevation (ABFE) is issued when new elevations are being established but have yet to be adopted.

Disaster Mitigation Act of 2000 (DMA 2000): This legislation established a requirement that jurisdictions nationwide must develop and implement natural hazard mitigation plans in order to remain eligible for various FEMA grant programs, including those that provide funding for hazard mitigation projects.

Federal Insurance Administration: A division of FEMA responsible for administering the flood insurance aspects of the NFIP.

Flood Insurance Study (FIS): A study that is produced by FEMA and evaluates flood hazard areas, describes its causes, and identifies flood protection measures. Depending on the area studied, the FIS may include water surface elevations. An FIS is developed in conjunction with a Flood Insurance Rate Map (FIRM).

Flood Insurance Rate Map (FIRM): The official map of a community for which FEMA has delineated both the special hazard areas (100-yr floodplain) and the risk premium zones applicable to the community.

Fujita Scale: The Fujita Scale measures tornado damage severity by assigning numerical values based on wind speeds. Tornadoes are categorizes from 0 to 5 depending on wind speeds. The letter "F" often precedes the numerical value.

Local Coordinators: Each municipality in New Jersey is required to have identified an individual to coordinate and carry out emergency management functions.

New Jersey Office of Emergency Management (NJOEM): NJ state agency state responsible for the comprehensive planning for and responding to all manner of disasters, whether man-made or natural. NJOEM may also be requested to provide consequence management for large special events.

Hazard Mitigation Grant Program (HMGP): Provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

HMGP Expanded Mitigation Strategies Planning Grant Pilot: After Hurricanes Katrina, Rita and Wilma in 2005, FEMA developed a process that expanded the allowable scope of mitigation planning activities that are funded through the HMGP. The Pilot provides funds for eligible HMGP Applicants to identify and plan feasible mitigation projects, and to incorporate those projects into their Mitigation Plans. The purpose of the Pilot is to utilize the mitigation planning strategies identified during the Plan Update to implement actual mitigation projects as part of the long-term disaster recovery.

National Flood Insurance Program (NFIP): A federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

Palmer Drought Index: This index was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information in a formula to determine dryness. It has become the semi-official drought index. The Palmer Index is most effective in determining long term drought.

Sea Lake and Overland Surges from Hurricanes (SLOSH) Model: Computer modeling software used to model storm surge heights from historical or hypothetical storms. The model can be used to estimate storm surge heights and winds by considering the pressure, size, forward speed, track and winds.

Special Flood Hazard Area (SFHA): A high risk area defined as any land that would be inundated by a flood having a 1% chance of occurring in any given year (see also BFE, 100-year flood). The SFHA is commonly identified on NFIP Flood Insurance Rate Maps (FIRMs). A structure located within a SFHA shown on a FIRM has a 26% chance of suffering flood damage during the term of a 30-year mortgage.

Steering Committee: Comprised of a cross section of individuals from emergency management, government and non-government to guide the planning process.

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Section 4
Adoption and Approval

Contents of this Section

4.1 IFR Requirement for Adoption and Approval

Requirement §201.6(c)(5): *[The local hazard mitigation plan shall include] documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., City Council, County Commissioner, Tribal Council). For multi-jurisdictional plans, each jurisdiction requesting approval of the plan* ***must*** *document that it has been formally adopted.*

Requirement §201.6(a)(3): *Multi-jurisdictional plans (e.g., watershed plans) may be accepted, as appropriate, as long as each jurisdiction has participated in the process … Statewide plans will not be accepted as multi-jurisdictional plans.*

4.2 Authority

In the State of New Jersey, counties are empowered to manage their own affairs via a governing body known as the Board of Chosen Freeholders. The following is an excerpt from the relevant portion of the New Jersey Statutes Annotated (N.J.S.A 40:20 et seq)[1]:

The property, finances and affairs of every county shall be managed, controlled and governed by a board elected therein, to be known as "the board of chosen freeholders of the county of [Middlesex] and the executive and legislative powers of the county shall be vested in that board of chosen freeholders, except where by law any specific powers or duties are imposed or vested in a Constitutional officer.

The board of chosen freeholders of any county which has created the office of county administrator, pursuant to the provisions of N.J.S. 40A:9-42, may, by resolution, delegate to that office such executive and administrative powers, duties, functions and responsibilities as the board may deem appropriate.

[1] Source: New Jersey Office of the Attorney General

4.3 Adoption and Approval Procedure

On October 4, 2010, FEMA Region II determined that the Middlesex County New Jersey Multi-Jurisdictional Hazard Mitigation Plan (the Plan) was "approvable pending adoption". On October 12, 2010, the Middlesex County Hazard Mitigation Steering Committee met and recommended that Middlesex County and the participating municipalities should adopt the Plan. The Plan was submitted to the Middlesex County Board of Chosen Freeholders as well as the appropriate entity for each participating municipality for review and adoption. The resulting Adoption Resolutions were then submitted to FEMA Region II for approval. FEMA subsequently issued formal approval letters to NJOEM for Middlesex County and each participating municipality that adopted the Plan. NJOEM, in turn issued approval letters to the approved jurisdictions.

4.4 Adoption Resolutions

Appendix H contains the signed Adoption Resolutions for Middlesex County and the participating municipalities.

4.5 Approval Letters

Appendix I contains the formal Approval Letters for Middlesex County and the participating municipalities.

Section 5
Planning Process

Contents of this Section

5.1 Interim Final Rule Requirements for the Planning Process

Requirement §201.6(c)(1): *[The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

Requirement §201.6(b): *An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:*

(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

5.2 Description of the Planning Process

5.2.1 Description of the Planning Process

The Middlesex County New Jersey Multi-Jurisdictional Hazard Mitigation Plan (the Plan) was prepared in accordance with the process established in the State and Local Mitigation Planning "how-to" Guides (FEMA Publication Series 386) produced by the Federal Emergency Management Agency (FEMA), and the requirements of the February 26, 2002 IFR. The process established in the FEMA 386 guides includes four basic steps.

- **Step 1**: Organize resources
- **Step 2**: Assess risks
- **Step 3**: Develop a mitigation plan
- **Step 4**: Implement the plan and monitor progress

5.2.2 Step 1: Organize Resources

The Middlesex County Office of Emergency Management (MC OEM) was the lead agency for the development of the Plan. At the beginning of the process, a consultant firm, James Lee Witt Associates, was hired to provide technical support. In addition, several individuals and organizations worked together to develop the Plan. These participants were organized into two different committees including:

- Middlesex County Hazard Mitigation Steering Committee
- Middlesex County Local Coordinators

The Middlesex County Hazard Mitigation Steering Committee (HMSC) was formed to provide the focus and leadership on behalf of the county in the development of its Plan. The HMSC was formed from a variety of county and local Office of Emergency Management staff, and county governmental staff. HMSC meetings were regularly attended by other key county agency staff, including representatives from departments of planning, public works, and additional emergency management staff; in addition to New Jersey Office of Emergency Management (NJOEM) staff.

The Middlesex County Local Coordinators is an established working group formed to have regular interactions with MC OEM. The Local Coordinators representatives from each participating municipality's Office of Emergency Management or related agency within the county as well as several public entities that wished to participate in the planning effort. The duties and responsibilities of the Local Coordinators consisted of; representing their communities interests as practical , serving as the point of contact for their communities with the HMSC, completing all assigned tasks such as data collection, identifying local mitigation actions, and reviewing the actions and plan product of the HMSC. The MCLC met monthly during the duration of the planning process to receive progress reports from the consultant, review and comment upon draft documents and procedures, and implement relevant tasking and coordinate efforts within their own communities.

Table 5.2.2-1a shows the primary membership of the HMSC.

Table 5.2.2-1:
Middlesex County Hazard Mitigation Steering Committee Members (HMSC)

Name	Organization
Rory Zach	Middlesex County OEM
John Ferguson	Middlesex County OEM
Larry Kolodziej	Middlesex County Engineer's Office
George Ververides	Middlesex County Department of Planning
Eric Aronowitz	Middlesex County Counsel's Office
Mark Anderka	Edison Township
Darren Doran	Helmetta Borough
Denise Jawidzik	Jamesburg Borough
Kathleen Anello	Middlesex Borough
Dominic Cicio	Old Bridge Township
Barry Eck	Sayreville Borough
Ron Fasanello	Spotswood Borough

The members of the Local Coordinators group included the following:

Table 5.2.2-2:
Middlesex County Local OEM Coordinators (MCLC)

Name	Organization
Daniel Beasley	Carteret Borough OEM
Ed Kahler	Cranbury Township PD/OEM
Bob Walker	Dunellen Borough OEM
John Kosik	East Brunswick Township OEM
Mark Anderks (*)	Edison Township OEM
Darren Doran (*)	Helmetta Borough OEM
Jeff Morris	Highland Park Borough OEM
Denise Jawidzik (*)	Jamesburg Borough
Jim Graziano	Metuchen Borough OEM
Kathleen Anello (*)	Middlesex Borough
Ray Geipel	Milltown Borough
Stephen Salerno	Monroe Township OEM
J.T. Miller	New Brunswick City PD
Walter Endler	North Brunswick Township OEM
Dominic Cicio (*)	Old Bridge Township OEM
Daniel Volk	Perth Amboy City OEM
Paul Snyder	Piscataway Township OEM
Rick Furda	Plainsboro Township PD
Barry Eck (*)	Sayreville Borough
Mark Herdman	South Amboy City
Kenneth Kersch	South Brunswick Township OEM
Michael Zushma	South Plainfield Borough OEM
Charles Benn	South River Borough OEM
Ron Fasanello (*)	Spotswood Borough OEM
Denis Henry	Woodbridge Township
Don Pascale	Rutgers University OEM
Jim Smith	UNDNJ OEM

Note: Local Coordinators with a (*) following their name also were members of the HMSC.

Meeting Schedule

There were several meetings conducted during the development of the Plan per Table 5.2.2-3. The meetings focused primarily on the review of work-in-progress for the development of the Plan. However, in some cases, the meetings were essentially working sessions for identification of potential mitigation projects.

Table 5.2.2-3:
Committee Meeting Schedule

Date	Meeting	Attendees
February 5, 2008	Steering Committee Meeting	MC OEM, HMSC, JLWA
February 26, 2008	Steering Committee Meeting	MC OEM, HMSC, JLWA
March 18, 2008	Local Coordinator's Meeting	MC OEM, Local Coordinators, HMSC, JLWA
March 19, 2008	P & C Meeting	MC OEM, JLWA
April 29, 2008	Steering Committee Meeting	MC OEM, HMSC, JLWA
May 27, 2008	Steering Committee Meeting	MC OEM, HMSC, JLWA
May 28, 2008	Local Coordinators' Meeting	MC OEM, Local Coordinators, HMSC, JLWA
July 15, 2008	Local Coordinators' Meeting	MC OEM, Local Coordinators, HMSC, JLWA
July 23,2008	Local Coordinators' & Public Meeting	MC OEM, Local Coordinators, JLWA, Public
August 12, 2008	Steering Committee Meeting	MC OEM, HMSC, JLWA

Appendix C.1 contains documentation for these meetings including agendas, sign-up sheets, presentation materials, and meeting notes where appropriate.

5.2.3 Step 2: Assess Risks

In accordance with general mitigation planning practice, as well as the process FEMA established in its "how-to" guides, the risk assessment forms the basis for this Plan by quantifying and rationalizing information about how natural and manmade hazards affect Middlesex County and the participating municipalities.

The processes used to complete the hazard identification and risk assessments, and the results of these activities, are described in Sections 6 and 7 and Appendix D of this Plan. The assessment determined several aspects of the risks of hazards faced by the county and the participating municipalities:

- The natural hazards that are most likely to affect Middlesex County
- How often hazards are expected to impact Middlesex County
- The expected severity of the hazards
- What areas of Middlesex County are likely to be affected by hazards
- How Middlesex County assets, operations, people and infrastructure may be impacted by hazards
- How private and commercial assets, operations, infrastructure may be impacted by hazards
- The expected future losses if the risk is not mitigated

The HMSC first identified all hazards with the potential to impact the County. Next, using a rating system (explained in detail in Section 6), the HMSC reduced the initial hazard list to six that were considered the most relevant for this type of planning process on a countywide basis. The results of this selection process were discussed and validated by the HMWG. These hazards are described in the Hazard Identification, Profiling, and Ranking portion of the plan (Section 6)

As a result of in-depth examination of the characteristics of the reduced list of hazards, the HMSC was able to make qualitative determinations that allowed further refinement of the focus of this plan to six hazards: flood, high wind – straight line winds, severe storm – winter weather, earthquake, hazardous materials. These are considered by the HMSC to represent the most predominant risks to the area and included:

For each of these hazards the consultants performed detailed risk assessments, i.e. calculations of future expected damages, expressed in dollars where appropriate. The results of the risk assessment were also made available to the public during the public presentations (see Section 5.3). The full process and results of this work is presented in the Risk Assessment portion of this Plan (Section 7).

5.2.4 Step 3: Develop the Mitigation Plan

The HMSC developed a series of goals and objectives in response to the results of the risk assessment. A capability assessment was also conducted to help determine the capacity of the County and the participating municipalities to implement hazard mitigation projects. In addition, the HMSC and the consultant worked with the participating municipalities, on an individual basis, to identify potential problems and hazard mitigation project solutions to include in the Mitigation Action Plan. The Mitigation Action Plan was discussed and validated by the HMWG. The results of these efforts are detailed in Sections 8 and 9.

5.2.5 Step 4: Implement the Plan and Monitor Progress

Finally, the HMSC identified a process for on-going monitoring and revisions to the Plan over the next five years. Section 10 details the resulting monitoring, evaluation and plan update procedures. This step was also reviewed and validated by the HMWG.

5.3 Involvement by the Public and Other Interested Parties

During the development of this Plan, the public was involved by requesting their participation in two public presentations/meetings, providing drafts of the Plan for review, and inviting comments on the contents of the Plan. The public presentations and meetings are detailed in Table 5.3-1.

Table 5.3-1:
Public Involvement

Date	Type of Involvement	Meeting Location
March 26, 2008	Local Capability Assessment Survey posted on county web site	n/a
April 3, 2008	Press release regarding hazard mitigation and Plan development issued	n/a
April 5,2009	County website posted with hazard mitigation and Plan development information posted	n/a
May 19, 2008	Citizens Survey posted on web[1]	County web site
July 23, 2008	Public meeting with presentation	MC Fire Academy
September 5, 2008	Draft Plan posted on web for comment	County web site
June 23, 2009	Public meeting and presentation of plan to Piscataway Township Council	Piscataway Administration Building
July 13, 2009	Public meeting and presentation of plan to Cranbury Township Council	Cranbury Administration Building
August 17, 2009	Public meeting and presentation of plan to Old Bridge Township Council	Old Bridge Administration Building
August 31, 2009	Public meeting and presentation of plan to Monroe Township Council	Monroe Administration Building
September 8, 2009	Public meeting and presentation of plan to Metuchen Borough Council	Metuchen Administration Building
September 20, 2009	Public meeting and presentation of plan to South Amboy City Council	South Amboy Administration Building

As part of the development of the Plan, Floodplain Administrators were engaged in Plan development and review in many municipalities. In some cases, the Municipal Coordinator who led work on this Plan was also the Floodplain Administrator for the community. Involvement of Floodplain Administrators in the development of the Plan is shown in Table 5.3-2. Proposed efforts to increase outreach to Floodplain Administrators will result in enhanced participation in the next Plan update.

Table 5.3-2
Middlesex County Floodplain Administrator Involvement

Municipality	Floodplain Administrator Name	Method of Involvement in Plan
Carteret Borough	John Dupont	Received updates and reviewed draft documents
Cranbury Township	Cathy Marcelli	Received working update from municipal point of contact and reviewed all drafts of plan documents
Dunellen Borough	Bill Robins	Received working update from municipal point of contact and reviewed all drafts of plan documents
East Brunswick Township	Greg Potkulski	Received working update from

[1] The Citizen Survey and a summary of responses are included in Appendix F.

Municipality	Floodplain Administrator Name	Method of Involvement in Plan
		municipal point of contact and reviewed all drafts of plan documents
Edison Township	Michael Mintchwarner	Received updates and reviewed draft documents
Helmetta Borough	Kevin Palmer	Received updates and reviewed draft documents
Highland Park Borough	Jeff Morris	Main point of contact
Jamesburg Borough	Denise Jawidzik	Main point of contact
Old Bridge Township	Jim Cleary	Received working update from municipal point of contact and reviewed all drafts of plan documents
Metuchen Borough	Kathrine Elliott	Received updates and reviewed draft documents
Middlesex Borough	Jack Costa	Main point of contact
Milltown Borough	Mike McCellan	Received working update from municipal point of contact and reviewed all drafts of plan documents
Monroe Township	Enist Feist	Received updates and reviewed draft documents
New Brunswick City	Thomas Guldin	Received working update from municipal point of contact and reviewed all drafts of plan documents
North Brunswick City	Tom Pawn	Not involved
Perth Amboy City	Larry Cattano	Received updates and reviewed draft documents
Piscataway Township	Paul Shyder	Main point of contact
Plainsboro Township	Neil Lewis	Main point of contact
Sayreville Borough	Barry Eck	Main point of contact
South Amboy City	Mark Rasimowicz	Not involved
South Brunswick Township	James Dowgin	Not involved
South Plainfield Borough	Michael Zushna	Main point of contact
South River Borough	Glenn Lauritsen	Received updates and reviewed draft documents
Spotswood Borough	Ron Fasanello	Received working update from municipal point of contact and reviewed all drafts of plan documents
Woodbridge Township	Scott Thompson	Received working update from municipal point of contact and reviewed all drafts of plan documents

Notes:
1.) Middlesex County does not include any unincorporated land not governed by municipalities and as a result does not have a floodplain management program per se.

In addition, notice was sent to adjacent jurisdictions and other interested parties that the Draft and Final Plans were available for review prior to adoption by the County and the participating municipalities. Minutes of meetings (and attendee lists) and copies of relevant correspondence are included in Appendix C.2-3.

5.4 Review and Incorporation of Plans, Studies, Reports and Other Information

Selected key federal sources of information and pre-existing planning work are presented in Table 5.4.1-1. Additional sources and detail can be found in Appendix B.

5.4.1 Federal Government

Table 5.4.1-1:
Federal Documents and Data Utilized

Existing Program/ Policy/ Technical Documents	Method of incorporation into the Plan
Federal Emergency Management Agency (FEMA). Disaster Declarations database	Utilized in hazard identification and risk assessment (HIRA) development an history of loss data
National Oceanic and Atmospheric Administration (NOAA	History and description of major hazard events
NOAA. State, Territory, and Commonwealth Beach Nourishment Programs	Historical data specific to potential mitigation actions
United States Geological Survey (USGS). Earthquake History in New Jersey	Utilized in HIRA development an history of loss data
NOAA/ NCDC database. History of Middlesex County extreme temperature events	History and description of major hazard events and HIRA development
FEMA. Flood hazard zones (“Q3”data)	HIRA development
FEMA. Hazardous material related Federal Disaster Declarations	HIRA development, strategy development ,mitigation action development
US EPA – Toxic Release Inventory	HIRA development, strategy development ,mitigation action development
US DOT. Hazardous Materials Incident Data	HIRA development, strategy development ,mitigation action development
NJDCA. Division of Codes and Standards: Bulletin No. 3-4 – Wind Speed Map	History and description of major hazard events and HIRA development
NOAA. Coastal Service Center – Historic Hurricane Tracks Database	HIRA development, strategy development ,mitigation action development
FEMA. Tornado Activity in the United States	Utilized in HIRA development an history of loss data
NJGS. Map of Landslides in New Jersey	Hazard profiling and loss estimation
NOAA. National Hurricane Center. Hurricane Preparedness - Storm Surge	HIRA development, strategy development
FEMA - Region II. Public Assistance Records	Hazard profiling and loss estimation

5.4.2 State of New Jersey

Selected state sources of information and pre-existing planning work are presented in this section.

New Jersey State Hazard Mitigation Plan

New Jersey completed the current 2008 State Plan update to meet the requirements of Interim Final Rule Section 201.4(d), which mandates that states update their mitigation plans every three years "to reflect changes in development, progress in State wide mitigation efforts, and changes in priorities."

The State Hazard Mitigation Plan is the demonstration of New Jersey's commitment to reduce risks from natural hazards and serves as a guide for both state and local decision makers as they commit resources to reducing the effects of natural hazards on lives and property. It is designed to outline a strategy to reduce risks from natural hazards in New Jersey, and to aid state and local emergency management officials in developing hazard reduction programs.

It is NJOEM's intent to use the State Plan as a way to provide data to local and regional governments to support their mitigation planning processes, and to provide guidance on best practices. For each on-going plan development effort, NJOEM attends at least one mitigation core team meeting, one stakeholder meeting, and one public meeting to be a resource to the municipality or county, to answer any questions and to direct planners to state resources or tools. NJOEM staff also is available during the draft plan development to answer any questions or provide guidance and assistance.

The state wide mitigation strategies, goals and objectives, methods of incorporating a varied cross section of relevant disciplines, hazard specific information, and specific data sources are present within the State Plan and were utilized in the development of the Middlesex County Multi-Jurisdictional Hazard Mitigation Plan.

Other State of New Jersey Information

In addition to the State Hazard Mitigation Plan, selected state sources of information and pre-existing planning work are presented in Table 5.4.2-1. Additional sources and detail can be found in Appendix B.

Table 5.4.2-1:
Other State Documents and Data Utilized

Existing Program/ Policy/ Technical Documents	Method of incorporation into the Plan
New Jersey Administrative Code – Dam Safety Standards (NJAC: 7-20). Dam Classifications NJOEM Summary of Presidentially Declared Disasters 1992 – 2000	Utilized in HIRA development
(NJDEP) – Department of Dam Safety and Flood Control.	Loss history, HIRA development
The New Jersey Beach Profile Network	History of dam failure events
New Jersey Geologic Survey (NJGS). *Earthquake Loss Estimation Study for Middlesex County*	Hazard profiling and loss estimation
State of New Jersey Department of Health. Department of Health and Senior Services. Right to Know Hazardous Substance	HIRA development

Existing Program/ Policy/ Technical Documents	Method of incorporation into the Plan
USACE - Philadelphia Office and FEMA. *New Jersey Hurricane Evacuation Study Transportation Analysis*	HIRA development, strategy development ,mitigation action development
New Jersey DEP. Middlesex County Land Use Land Cover data	Hazard profiling and loss estimation
New Jersey State Development and Redevelopment Plan	To assess potential loss utilized in the HIRA
NJ Department of Community Affairs - Office of Smart Growth. Geographical Information System (GIS) data.	HIRA development, strategy development
NJOEM – Hazard Analysis New Jersey	Used in developing hazard profiling
NJ Office of the State Climatologist (at Rutgers U.)	Used in developing hazard profiling

5.4.3 Middlesex County

New Jersey is a “home rule” state which simply means that the authority to create laws and control land use resides within the municipal governments and not with the county governmental entities. Counties throughout New Jersey are expected to act at times in the best interest and for the protection of the citizens residing within the confines of the county. State statutes do give limited authorities to the counties but the more significant authorities rest with the individual municipalities.

Selected key county sources of information and pre-existing planning work are presented in Table 5.4.3-1. Additional sources and detail can be found in Appendix B.

Table 5.4.3-1:
County Documents and Data Utilized

Existing Program/ Policy/ Technical Documents	Method of incorporation into the Plan
Middlesex County website: Public Health Department - Hazardous Materials Unit	HIRA development, mitigation actions development
Construction Permits	Mitigation actions development
Critical Facilities	HIRA development, mitigation actions development
Photographs of critical facilities	Used in development of risk assessments and mitigation actions
Emergency Operations Plan	Used in hazard identification
Dams inventory and data	Used in development of HIRA and mitigation actions
Cross-Acceptance Report (2004)	Used to validate data used in future development analysis
RL/SRL inventory and data	Used in development of risk assessments and mitigation actions

5.4.4 Municipalities

Upon initiating the plan development process, the County OEM point of contact made initial contacts to form the HMSC. Concurrent with that effort, all of the local OEM coordinators were made aware of the significance this planning effort. A comprehensive "wish list" of documents, data sources, maps, studies, Emergency Operations Plans, land use data, laws and ordinances was provided with the task of collecting as much of the items as possible. The HMSC and MC OEM regularly provided guidance and support in this gathering effort through the use of e-mail inquiries, phone contact and agenda items at the Local Coordinator meetings.

Selected key municipal sources of information and pre-existing planning work are presented in Table 5.4.4-1. Additional sources and detail can be found in Appendix B.

Table 5.4.4-1:
Municipal Documents and Data Utilized

Existing Program/ Policy/ Technical Documents	Method of incorporation into the Plan
Municipal Tax records	To assess potential loss utilized in the HIRA
Utility maps	To assess locations of CF
Critical Facilities Lists	Utilized in the HIRA and in developing mitigation actions
PA records	To compile loss histories
Evacuation Plans	Identify hazard areas
Response Plans	Coordinate mitigation actions and develop strategies
Mitigation 20/20 reports	Used in development of planning context, hazard identification, risk assessment, and critical facilities identification/ mitigation actions
Photographs of critical facilities	Used in development of risk assessments and mitigation actions
RL/SRL inventory and data	Used in development of risk assessments and mitigation actions

Table 5.4.4-2
Complete Inventory (per FEMA Region II "Tool Kit") of Potential Municipal Documents and Data, and Status of Inclusion in Plan

Document or Data (for all Municipalities in Middlesex Co.)	Reviewed for Plan? (1)	Status of Incorporation in Plan
Comprehensive plan	Y	Reviewed. See Table 5.4.3-1 (reviewed in summary form in Cross Acceptance Report)
Growth Management plan	Y	Reviewed. See Table 5.4.3-1 (reviewed in summary form in Cross Acceptance Report)
Capital Improvement plan	N	To be reviewed (if available) and included in plan update
Flood Damage Prevention Ordinance	N	To be reviewed (if available) and included in plan update
Floodplain Management plan	N	To be reviewed (if available) and included in plan update
Open Space program plan	N	To be reviewed (if available) and included in plan update
Flood Insurance Studies, DFIRMs or engineering studies for streams	N	To be reviewed (if available) and included in plan update
Hazard Vulnerability Analysis (by the local Emergency Management Agency)	Y	Reviewed. See Table 5.4.4-1

Document or Data (for all Municipalities in Middlesex Co.)	Reviewed for Plan? (1)	Status of Incorporation in Plan
Emergency Management Plan/ Emergency Operations Plan	Y	Reviewed. See Table 5.4.3-1
Zoning Ordinance	N	To be reviewed (if available) and included in plan update
Building Code	Y	Reviewed. Standard UCC for all of NJ
Drainage Ordinance	N	To be reviewed (if available) and included in plan update
Critical Facilities maps	Y	Reviewed. See Table 5.4.4-1
Existing Land Use maps	Y	Reviewed. See Table 5.4.3-1 (reviewed in summary form in Cross Acceptance Report)
Elevation Certificates	N	To be reviewed (if available) and included in plan update
State plan	Y	Reviewed. See Table 5.4.2.1
HAZUS study	Y	Reviewed. See Table 5.4.1-1
SLOSH Studies	Y	Reviewed. See Table 5.4.1-1 (USACE Evacuation Study)
Hurricane Evacuation Plan	Y	Reviewed. See Table 5.4.1-1 (USACE Evacuation Study)

Notes:

(1) Documents were requested of the HMSC members by MCOEM. Documents that were not reviewed for the Plan were not provided by participating municipalities. It was not determined as part of this project if any or all of these documents exist. As noted in this table, plans and documents that were not reviewed as part of this project will be pursued and, if available, reviewed and included in subsequent plan update(s). This activity will be part of the work effort included in Action Item 1.C.1 as indicated in Table 9.3.2-1 which addresses Objective 1.C: "*Increase local government official awareness regarding opportunities for participation in and contributing to future Plan updates.*"

5.4.5 Other Resources

Selected other key sources of information and pre-existing planning work, including regional and academic resources, are presented in Table 5.4.5-1. Additional sources and detail can be found in Appendix B.

Table 5.4.5-1:
Other Documents and Data Utilized

Existing Program/ Policy/ Technical Documents	Method of incorporation into the Plan
New Jersey Association of County Tax Boards – parcel data	Used to validate data used in risk assessment
Public Entity Risk Institute – Presidential Disaster Declarations	Used in developing hazard profiling and loss estimation
Right-to-Know (RTK) network – biennial reporting, emergency response notification database	Used in developing hazard profiling

Section 6
Hazard Identification, Profiling and Ranking

Contents of this Section

6.1 IFR Requirement for Hazard Identification and Profiling

IFR §201.6(c)(2)(i): *[The risk assessment shall include a] description of the…location and extent of all natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.*

Note that Appendix D includes general descriptions of all selected hazards that can affect Middlesex County. The present section addresses the specific requirements of the IFR with regard to hazards in the planning area.

6.2 Hazard Identification

In accordance with IFR requirements, and as part of its efforts to support and encourage hazard mitigation initiatives, Middlesex County's Hazard Mitigation Steering Committee (HMSC) prepared this general assessment of the hazards that have potential to impact the County. The following subsections provide an overview of past hazard events in the County and brief descriptions of the potential for future losses. Section 7 (Risk Assessment) includes much more detailed information about past and potential losses (risk) from a subset of the most significant hazards in Middlesex County.

The term "planning area" is used frequently in this section. This term refers to the geographic limits of Middlesex County. The Risk Assessment section addresses the effects of hazards on Middlesex County and its citizens.

Overview of Middlesex County's History of Hazards

Numerous federal agencies maintain a variety of records regarding losses associated with hazards. Unfortunately, no single source is considered to offer a definitive accounting of all losses. The Federal Emergency Management Agency (FEMA) maintains records on federal expenditures associated with declared major disasters. The U.S. Army Corps of Engineers and the Natural Resources Conservation Service collect data on losses during the course of some of their ongoing projects and studies. Additionally, the National Oceanic Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) database collects and maintains data about hazards in summary format. The data includes occurrences, dates, injuries, deaths, and costs.

According to the NCDC database, between 1950 and 2007, Middlesex County has experienced the following hazard events.

- 193 thunderstorm and high wind events (nine exceeding 69 mph)
- 94 winter storms (four major blizzards/ severe winter storms)
- 47 floods/flash floods
- 36 droughts
- 22 hail storms (four of which had greater than 1" diameter hail)
- 28 significant lightning events
- 11 hurricanes or tropical storms
- 10 extreme heat events
- 7 tornadoes (five F0s and two F1s)
- 7 wildfires
- 6 extreme cold temperature events
- 4 ice storms (32 wintry mix events)
- 0 storm surge events (10 coastal flooding events)

In addition to the events recorded in the NCDC database other sources identified four earthquakes, and one dam failure. A number of these events caused property damage, injuries, and loss of life[1]. These figures are discussed in more detail in the hazard-specific subsections that follow.

[1] NOAA/ NCDC database

In the absence of definitive data on some of the hazards that may occur in Middlesex County, illustrative examples are useful. Table 6.2.1-1 provides brief descriptions of particularly significant hazard events occurring in Middlesex County's recent history. This list is not meant to capture every event that has affected the area, rather lists some of the more significant events that have occurred here in the past.

Middlesex County has received five Presidential Disaster Declarations since 1950 (1992, 1993, 1996, 1999 – Hurricane Floyd; and 2007). The five Declared disasters are included as part of the summary in Table 6.2.1-1 below. Since 1996, all of the major disasters declared in Middlesex County have been the result of significant flooding. One of the floods resulted from a downgraded hurricane.

Table 6.2.1-1
Recent Hazards and Declared Major Disasters in Middlesex County, New Jersey
(1996 to 2007)
(Sources: NOAA/NCDC; Federal Emergency Management Agency (FEMA); NJ Office of Emergency Management)

Date & Disaster (DR)	Nature of Event
12/1992 (DR-973)	SEVERE STORMS AND INLAND AND COASTAL FLOODING – A major winter storm (Nor'easter) that caused considerable coastal flooding and beach erosion. A total of 12 counties in NJ included as part of the Presidentially Declared Disaster.
3/13/1993 (DR-3106)	SEVERE STORMS AND FLOODING – Event know as the "Storm of the Century" affected as many as 26 States from Florida to Maine, the Gulf Coast, and the Ohio Valley. One of the most intense nor'easters to ever effect the United States. The "storm of the Century" label was given to the event due to the record low pressure, wind speeds, temperature and snowfall. All 21 counties in New Jersey were included in the Presidentially Declared Disaster.
1/7/1996	BLIZZARD - A State of Emergency was declared for the blizzard that hit the State. Snowfall amounts ranged from 30 inches in the interior sections of the County to 14 inches along the coast. Road conditions were dangerous due to the high winds and drifts. Both government and contract snow plowing operations were running at a maximum. Local roads were impassable. This blizzard also brought on coastal flooding with the high tides of Sunday evening and Monday morning, and there were reports of damage to dunes and beaches from the heavy wave activity. More than 400 National Guard personnel were activated for transport assistance, primarily for medic missions. In Middlesex County snowfall totals ranged from 19-32 inches.
10/19/1996 (DR 1145)	Flash Flood – The flash flooding event caused an estimated $2.7 million in damages in Middlesex County. Flooding temporarily closed parts of US 1 and 9, several State routes, and the Garden State Parkway. In Dunellen 20 homes were damaged by the floodwaters.
11/19/1996	SEVERE STORMS AND FLOODING – This Nor'easter stalled for 8 hours over central New Jersey, causing heavy rainfall and street flooding in areas of Middlesex County.
9/16/1999 (DR -1295)	HURRICANE FLOYD – This downgraded fall hurricane put the entire Eastern Seaboard on flood watch, including every county in New Jersey. The storm lasted approximately 18 hours and caused an estimated $3.5 million in damages to public infrastructure in Middlesex County. In Middlesex County, floodwaters from the Raritan River caused severe flooding. As the Raritan River was rising, the incoming high tide during the early morning of the 17th prevented it from discharging into the bay. A total of 500 homes were damaged in Middlesex Borough. Residential damages were estimated at $6 million.
8/5/2003	SEVERE STORMS AND FLOODING – Thunderstorms with heavy rains caused flooding in the northwest part of the County. Rainfall totals from the storm were estimated at 2-5 inches and resulted in $250,000 in damages.

Date & Disaster (DR)	Nature of Event
7/17/2005	SEVERE STORMS AND FLOODING – Flash flooding occurred in the Manalapan Brook Basin in southeastern Middlesex County impacting seven municipalities; East Brunswick, Jamesburg, Monroe, Spotswood, Helmetta, South River and Old Bridge. Collectively the flood damages to these areas totaled $9.7 million. A total of 308 homes, 25 apartments, 20 businesses and one industrial facility were damaged.
2/12/2006	SEVERE STORMS AND INLAND AND COASTAL FLOODING – A major winter storm (Nor'easter) that impacted the New Jersey shoreline with strong onshore winds that caused coastal flooding and beach erosion. In Middlesex County the area of South Amboy was impacted by coastal flooding.
4/15/2007 (DR -1694)	SEVERE STORMS AND INLAND AND COASTAL FLOODING – A 7-day Nor'easter deluged New Jersey with over 9 inches of rain, causing millions of dollars of damage and killing three residents. In Middlesex County nearly every municipality suffered flood damages or roads closed due to the extensive flooding.

Weather-Related Deaths and Injuries

According to the National Climatic Data Center, Middlesex County has experienced 49 deaths and 402 injuries from natural hazards in the period from 1950 to 2007[2].

6.3 Overview of the Type and Location of Hazards that can affect Middlesex County

In the initial phase of the planning process, Middlesex's Hazard Mitigation Steering Committee (HMSC) considered 28 natural and technological hazards and the risks they create for the County and its material assets, operations, and staff. The hazards initially considered are shown in Table 6.3-1.

[2] http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms

Table 6.3-1

**Preliminary Hazard List
Middlesex County**

Hazard	Type (1)	PDM Application	MC EOP (2)	Mitigation 20/20	NJSHMPU	Consultant SOW	Include in HMP?
Aircraft Incidents	T		✓				No
Air Pollution	T		✓				No
Civil Disturbance	I			✓			No
Crime	I			✓			No
Dam Failure	**T**					✓	**Yes**
Drought	**N**			✓	✓	✓	**Yes**
Earthquake / Geological (4)	**N**	✓			✓	✓	**Yes**
Enemy Attack / Terrorism	I		✓	✓			No
Erosion – Hurricane/Nor'easter/Coastal Storm	**N**	✓			✓		**Yes**
Extreme Temperature / Cold	**N**	✓			✓		**Yes**
Extreme Temperature / Heat	**N**		✓		✓		**Yes**
Flood	**N**	✓	✓	✓	✓	✓	**Yes**
Hail	**N**		✓	✓	✓	✓	**Yes**
Hazardous Materials Release – Fixed Site	**T**		✓	✓		✓	**Yes**
Hazardous Materials Release – Transportation	**T**		✓	✓		✓	**Yes**
High Wind – Straight-line Wind (5)	**N**	✓	✓	✓	✓	✓	**Yes**
High Wind – Tornado	**N**	✓	✓	✓	✓	✓	**Yes**
Ice Storm	**N**		✓			✓	**Yes**
Landslide (non-seismic)	**N**	✓				✓	**Yes**
Pandemic Disease / Infestation	B		✓	✓			No
Radiological Incident	T			✓			No
Railroad Incidents	T		✓				No
Severe Storm - Lightning	**N**	✓		✓			**Yes**
Severe Storm – Winter Weather	**N**	✓		✓	✓		**Yes**
Storm Surge – Hurricane/Nor'easter/Coastal Storm -	**N**	✓		✓	✓		**Yes**
Utility Failure (gas, power, sewer, telecom, water)	T		✓	✓			No
Urban Fire	I		✓	✓			No
Wildfire	**N**	✓	✓		✓	✓	**Yes**

Table Notes:

1. Type Legend: B = Biological; I = Intentional Acts; N = Natural; T = Technological / Manmade
2. MC EOP = Middlesex County Emergency Operations Plan
3. NJSHMPU State of New Jersey Hazard Mitigation Plan Update (approved by FEMA in April 2008).
4. Earthquake / Geological includes effects of surface faulting, ground shaking, earthquake induced landslides and liquefaction.
5. High Wind – Straight-line Wind includes winds due to hurricanes, tropical storms, nor'easters, coastal storms, and other severe storms, excluding tornados.

In the initial identification process, the HMSC catalogued potential hazards to identify those with the most chance to significantly affect the County. The hazards include those that have occurred in the past and may occur in the future. A variety of sources were used in the investigation. These included national, regional, and local sources such as emergency operations plans, the State Hazard Mitigation Plan, websites, published documents, databases, and maps, as well as discussion with the HMSC staff.

The HMSC reviewed the 28 hazards and determined that 10 of these hazards were the result of intentional acts or were due to biological or technological hazards that were not consistent with traditional hazard mitigation planning and implementation processes. These 10 hazards were referred to the Middlesex County Office of Emergency Management for further action as part of appropriate preparedness activities (e.g., emergency operations planning). The remaining 18 hazards, listed below, were selected for inclusion in the plan by the HMSC.

1. Dam Failure
2. Drought
3. Earthquake / Geological
4. Erosion – Hurricane / Nor'easter / Coastal Storm
5. Extreme Temperature – Cold
6. Extreme Temperature – Heat
7. Flood
8. Hail
9. Hazardous Materials Release – Fixed Site
10. Hazardous Materials Release – Transportation
11. High Wind – Straight-line Winds
12. High Wind – Tornado
13. Ice Storm
14. Landslide (non-seismic)
15. Severe Storm - Lightning
16. Severe Storm – Winter Weather
17. Storm Surge – Hurricane / Nor'easter / Coastal Storm
18. Wildfire

The following section profiles the 18 hazards listed above, and includes a description of the hazard, location and extent of the hazard, severity of the hazard, impact on life and property, and past occurrences.

6.3.1 Dam Failure

Description of the Dam Failure Hazard

A dam is defined by the New Jersey Department of Environmental Protection (NJDEP) as any artificial dike, levee or other barrier that is constructed for the purpose of impounding water on a permanent or temporary basis, that raises the water level five feet or more above the usual, mean, low water height when measured from the downstream toe-of-dam to the emergency spillway crest or, in the absence of an emergency spillway, the top-of-dam[3].

[3] NJDEP

Dam failures can result from a variety of causes including lack of maintenance, seismic activity, improper design or construction, or the effects of large storms. Significant rainfall can quickly inundate an area and cause floodwaters to overwhelm a reservoir. If the spillway of the dam cannot safely pass the resulting flows, water will begin flowing in areas not designed for such flows and failure may occur[4]. See Appendix D for a more detailed description and definition of the dam failure hazard.

To prevent, or reduce the probability of a failure, existing dams are periodically inspected by professional engineers on a regular basis. Table 6.3.1-1 summarizes the dam inspection schedule for New Jersey, including Middlesex County.

Table 6.3.1-1:
New Jersey Dam Inspection Schedule
(Source: NJDEP – Dam Safety and Flood Control)

Dam Class	Regular Inspection	Formal Inspection
Class I Large Dam	annually	once every 3 years
Class I Dam	once every 2 years	once every 6 years
Class II Dam	once every 2 years	once every 10 years
Class III Dam	once every 4 years	only as required
Class IV Dam	once every 4 years	only as required

Location of the Dam Failure Hazard

According to the NJDEP there are a total of 38 dams in Middlesex County. The following table is a listing of all Middlesex County dams including the municipality name, hazard classification, the river or stream the dam is located along, the last inspection date and the name of the dam. The table is ordered by hazard classification which ranks the potential for infrastructure and property damages downstream if a dam failure were to occur. The three hazard classifications include high hazard (H), significant (S), and low (L), and are defined at the bottom of the table.

In Middlesex County three dams are classified as high hazard by the NJDEP - Bureau of Dam Safety and Flood Control; Farrington Dam, Manalapan Lake Dam, and Devoe Lake Dam. The New Jersey Department of Environmental Protection database does not include the data points listed as “na” in the table.

[4] NJDEP

Table 6.3.1-2:
Inventory of Middlesex County Dams, ordered by Hazard Classification
(Source: NJDEP – Dam Safety and Flood Control, New Jersey Administrative Code – Dam Safety Standards)

Municipality Name	Dam Name	Hazard Class	River/Stream	Height (ft)	Length (feet)	Last Date Inspected
East Brunswick Township	Farrington Dam	H	Lawrence Brook	34	535	12/21/2006
Jamesburg Borough	Manalapan Lake Dam	H	Manalapan Brook	15	213	4/16/2007
Spotswood Borough	Devoe Lake Dam	H	Manalapan Brook	15	290	7/25/2006
Cranbury Township	Brainerd Lake Dam	S	Cranbury Brook	12.5	382	11/6/2007
Edison Township	Roosevelt Park Dam	S	South Branch Rahway River	7.7	638	10/1/2007
Helmetta Borough	Helmetta Dam	S	Manalapan Brook	7	2000	12/28/2004
New Brunswick City	Westons Arch Dam	S	Lawrence Brook	17	248	12/21/2006
New Brunswick City	Weston Mill Pond Dam	S	Lawrence Brook	15.5	309	12/21/2006
North Brunswick Township	Davidsons Mill Pond Dam	S	Lawrence Brook	9.5	135	12/21/2006
Old Bridge Township	Duhernal Dam	S	South River	13	878	10/20/2005
Piscataway Township	New Market Pond Dam	S	Bound Brook	7	300	1/8/2008
Plainsboro Township	Plainsboro Pond Dam	S	Cranbury Brook	10.62	500	9/22/2006
South Brunswick Township	Princeton Walk Dam	S	Carters Brook	16	400	12/3/2001
Woodbridge Township	Green Street Dam	S	Rahway River	8	755	4/13/2007
Edison Township	Silver Lake Dam	L	Raritan-TR	31	200	11/4/2005
Middlesex Borough	Creighton Lake Dam	L	Ambrose Brook	10.8	200	3/16/2005
Milltown Borough	Mill Pond Dam	L	Lawrence Brook	7.5	200	8/30/2007
Milltown Borough	Ryders Crossing Regional Detention Basin	L	Lawrence Brook-TR	11.5	360	1/28/2000
Monroe Township	Monroe Hunt Pond Dam	L	Manalapan Brook-TR	na	na	6/27/2005
Monroe Township	Mount's Mills Dam	L	Matchaponix Brook	na	na	Unknown
Monroe Township	Bloomfield Mills #1 Dam	L	South River	10	200	Unknown
Monroe Township	Bloomfield Mills #2 Dam	L	South River	12	81	Unknown
Monroe Township	Glen Rock Dam	L	Branch Manalapan Brook	9	250	Unknown
North Brunswick Township	Heritage Park Dam	L	Farrington Lake-TR	16	250	Unknown
North Brunswick Township	Hidden Lake Dam	L	6 Mile Run-TR	19	150	11/17/2001
Old Bridge Township	Deep Run Dam	L	Deep Run	10	1800	3/14/2002
Old Bridge Township	Tennents Brook Dam	L	Tennents Brook	9	600	11/21/2000
Old Bridge Township	Logan's Lake Dam at Cheesequake Village	L	Cheesequake Creek	30	170	5/24/2004

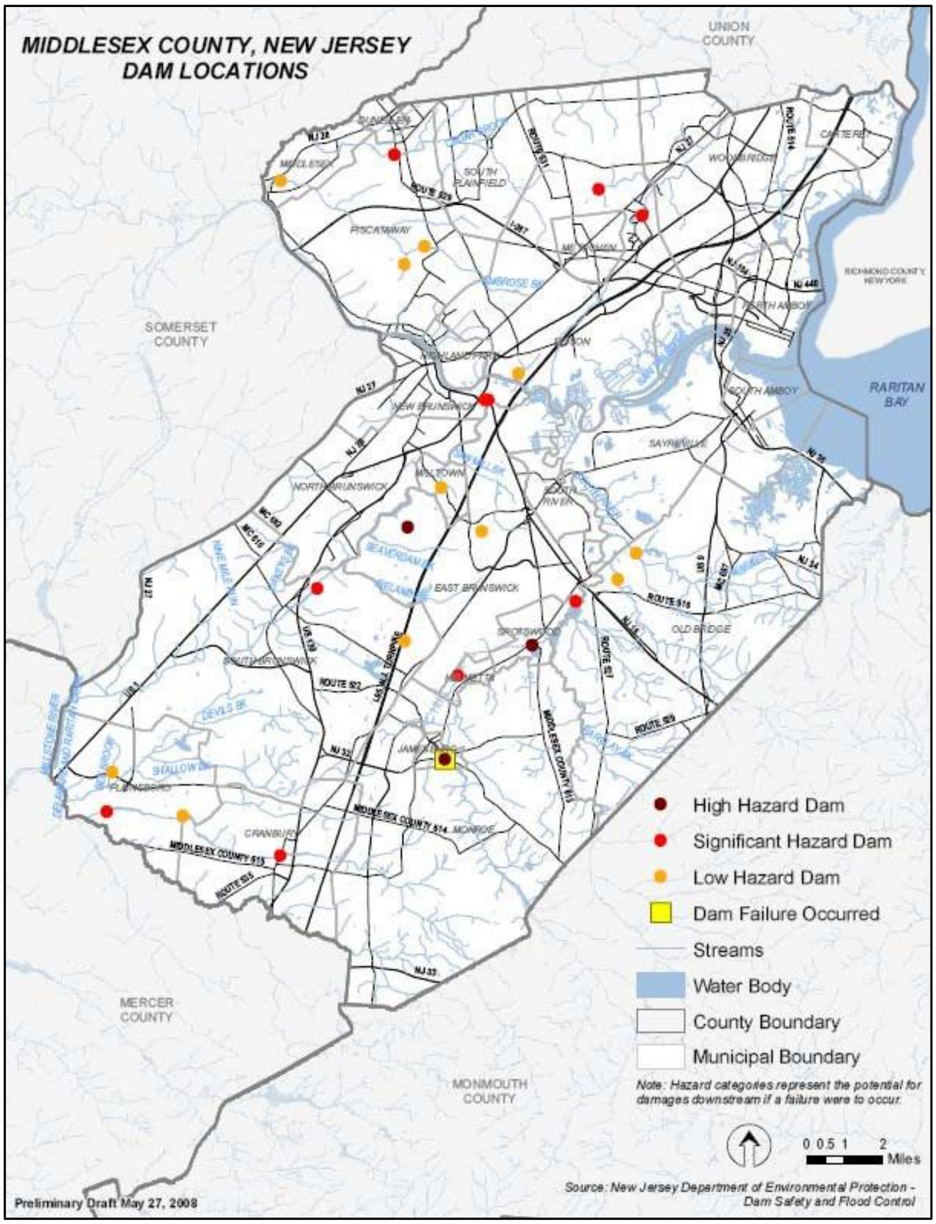
Municipality Name	Dam Name	Hazard Class	River/Stream	Height (ft)	Length (feet)	Last Date Inspected
Old Bridge Township	Hooks Creek Lake Dam	L	Cheesequake Creek	na	na	3/16/2005
Old Bridge Township	Maiden Woods Dam	L	Tennants Brook-TR	na	800	Unknown
Piscataway Township	Piscataway Dam	L	Ambrose Brook-TR	8.1	380	Unknown
Piscataway Township	Lake Nelson Dam	L	Ambrose Brook	10.5	487	11/9/2000
Plainsboro Township	Bee Brook Detention Dam	L	Bee Brook	11	210	12/16/1991
Plainsboro Township	Walker Gordon Pond Dam	L	Devils Brook	8	na	9/29/1995
Plainsboro Township	Plainsboro/Cranbury Dam	L	Millstone River	8	540	2/4/2008
Plainsboro Township	D & R Canal Dam	L	Millstone River	na	160	Unknown
South Brunswick Township	Middlesex Center Warehouse Dam	L	Offstream	10.5	1300	1/29/2007
South Brunswick Township	Reisert Pond Dam	L	Heathcote Brook	7	150	Unknown

Hazard Classes (Source: New Jersey Administrative Code - Dam Safety Standards (NJAC: 7-20): Dam Classifications)

H = High Hazard: Loss of life likely (if failure were to occur)
S = Significant Hazard: Loss of life not likely, but the potential for significant property damage
L = Low Hazard: Loss of life not likely and minimal infrastructure and property damage other than the structure itself

The following map identifies the location for 25 of the 38 dams in Middlesex County. The inventory of dams was provided by the NJDEP - Bureau of Dam Safety and Flood Control. The latitude and longitude coordinates were missing for 13 of the dams and therefore not identified on the map.

Figure 6.3.1-1
Middlesex County Dams
(Source: NJDEP – Dam Safety and Flood Control)



Note:
13 dams without latitude and longitude coordinates were excluded from the map: Heritage Park Dam, Walker Gordon Pond Dam, Monroe Hunt Pond Dam, D & R Canal Dam, Mount's Mill Dam, Bloomfield Mill Dams #1 and #2, Glen Rock Dam, Reisert Pond Dam, Hidden Lake Dam, Logan's Lake Dam at Cheesequake Village, Hooks Creek Lake Dam, and Maiden Woods Dam.

Severity of Dam Failure Hazard

In 1921, the New Jersey Legislature created the Bureau of Dam Safety and Flood Control, which instituted laws relating to the construction, repair, and inspection of existing and proposed dam structures. The law was amended in 1981, and became known as the Safe Dam Act. New Jersey's Dam Safety program is administered by NJDEP's Division of Engineering & Construction, Dam Safety Section[5] .

The severity of a dam failure event can depend on various aspects related to the size of the dam, the extent of the failure, the velocity of the floodwaters released, and the intensity of the downstream development.

Impact on Life and Property

According to the National Inventory of Dams as of 2005 there were 79,500 dams in the United States. Approximately one third of these pose a "high" or "significant" hazard to life and property if failure occurs. Dam failure has the potential for catastrophic impact on life and property. This risk can be reduced by proper design, construction and routine maintenance and inspection.

Occurrences of the Dam Failure Hazard

The NJDEP indicates there have been no previous catastrophic dam failures in New Jersey, but the number of small failures has risen over the past few years. This has been primarily due to a combination of lack of inspection and the number of dams nearing the end of their design life[6].

The NJDEP – Bureau of Dam Safety and Flood Control lists dam failures in New Jersey from several major flooding events including Hurricane Floyd in 1999 and the Sparta storm in 2000. For these two events no dam failures were listed for Middlesex County. The Bureau of Dam Safety did identify a dam failure event that occurred on September 20, 1989 at Manalapan Lake Dam. Heavy rains overtopped an area adjacent to the dam which caused partial failure and severe flooding downstream. No additional failures were identified for Middlesex County. Based on the one partial dam failure event in Middlesex County over the past 15 years, the likelihood of a major failure occurring in the future is presumably low. To assess the dam failure risk in Middlesex County the HMSC determined that the Brainard Lake Dam and Green Street Dam would be analyzed further as part of the risk assessment. Both dams are classified as “Significant Hazard” by the NJDEP – Bureau of Dam Safety and Flood Control. See Section 7.3.6, Dam Failure Risk in Middlesex County, for a more detailed analysis of these dams.

[5] NJDEP
[6] NJDEP

6.3.2 Drought

Description of the Drought Hazard

A drought is an extended dry climate condition when there is not enough water to support urban, agricultural, human, or environmental water needs. It usually refers to a period of below-normal rainfall, but can also be caused by drying bores or lakes, or anything that reduces the amount of liquid water available. Drought is a recurring feature of nearly all the world's climatic regions. See Appendix D for a more detailed description and definition of the drought hazard.

Location of the Drought Hazard

Droughts may occur anywhere in the United States. Effects seen in different regions vary depending on normal meteorological conditions such as precipitation and temperature, as well as geological conditions such as soil type and subsurface water levels.

Drought is possible throughout the planning area, but the data has revealed no significant drought history since 1950.

Severity of the Drought Hazard

A drought's severity depends on numerous factors, including duration, intensity, and geographic extent as well as regional water supply demands by humans and vegetation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity[7]. Due to its multi-dimensional nature, drought is difficult to define in exact terms and also poses difficulties in terms of comprehensive risk assessments.

Impact on Life and Property

There are no known deaths or injuries from droughts in the planning area.

Occurrences of the Drought Hazard

According to the NCDC database, Middlesex County has experienced 36 drought events in the period from 1950 to 2007. All 36 events are between 1995 and 2005. The database provides no indication as to why there are no events prior to 1995, although presumably occurrences follow the same pattern and frequency as shown in the NCDC list. The events are listed by months. For example, if a drought lasts several continuous months, it is listed in the database as separate events. If the continuous months are combined into single events, the number of events is reduced from 36 to 11 events.

Based on previous occurrences, it is reasonable to assume that droughts will continue in the Middlesex County, but with no injuries, deaths, or property damage the impact will continue to be reasonably low.

[7] FEMA, 1997

6.3.3 Earthquake / Geological

(Includes surface faulting, ground shaking, earthquake induced landslide, and liquefaction)

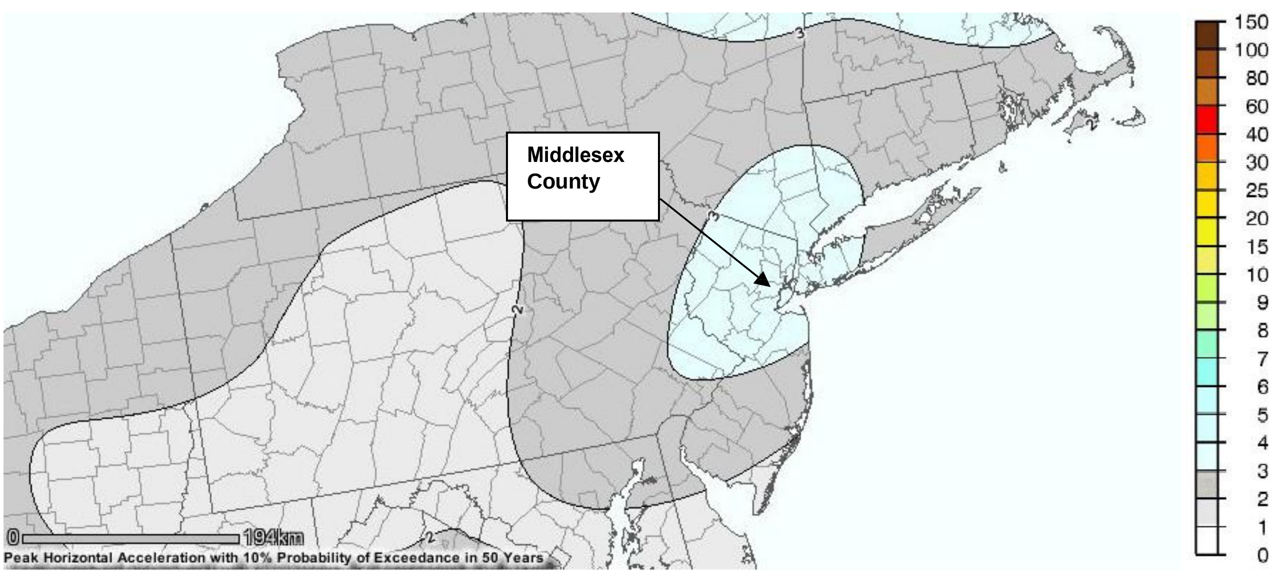
Description of the Earthquake Hazard

An earthquake is a sudden release of energy from the earth's crust that creates seismic waves. Tectonic plates become stuck, putting a strain on the ground. When the strain becomes so great that rocks give way, fault lines occur. At the Earth's surface, earthquakes may manifest themselves by a shaking or displacement of the ground, which may lead to loss of life and destruction of property. Size of an earthquake is expressed quantitatively as magnitude and local strength of shaking as intensity. The inherent size of an earthquake is commonly expressed using a magnitude. See Appendix D for a more detailed description of the earthquake hazard.

Location of the Earthquake Hazard

The entire planning area is susceptible to the effects of earthquakes. Figure 6.3.3-1 displays the northeast portion of a United States Geological Survey (USGS) earthquake hazard map produced in 2008. The map shows peak ground acceleration (pga) with a 10% chance of being exceeded over 50 years is highest in northeastern NJ (6%g) and decreasing to the south (2%g). The *FEMA How-To guidance, Understanding Your Risks*, FEMA 386-2, p. 1-7, suggests the earthquake hazard should be profiled if the pga is greater than 3%g. The map shows that the north central part of New Jersey, including Middlesex County, is located in the 3%g range, slightly higher risk area than the southern part of the state.

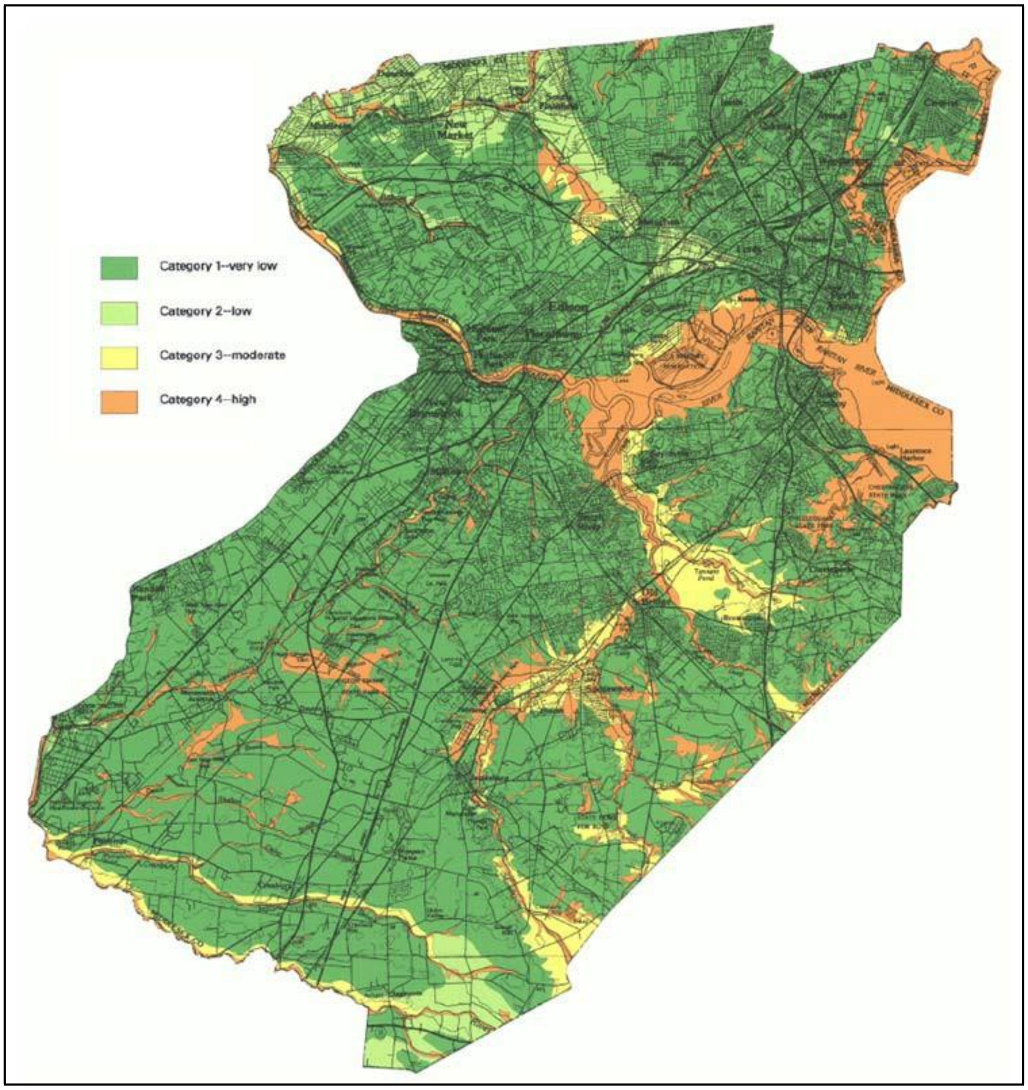
Figure 6.3.3-1
New Jersey Seismic Hazard Map, showing Peak Ground Acceleration in Percent of *g*, with 10 % exceedance in 50 years.
(Source: USGS, 2008)



In 2003 the New Jersey Geologic Survey (NJGS) completed an *Earthquake Loss Estimation Study for Middlesex County.* The NJGS acquired and analyzed geologic, topographic and test-boring data in order to map seismic soil class, liquefaction susceptibility, and landslide susceptibility for Middlesex County. The soil class, liquefaction, and landslide susceptibility were then entered into the HAZUS model for each census track in the county.

The Study completed by the NJGS identified and mapped the distribution and thickness of 12 surface materials for Middlesex County. Mapping the soil type for each census track identifies areas that are susceptible to soil liquefaction. Figure 6.3.3-2 below is a soil liquefaction map for Middlesex County. The map identifies the northeast County border and the Raritan River floodplain as the main areas of high susceptibility for soil liquefaction.

Figure 6.3.3-2
Middlesex County, New Jersey Soil Liquefaction Susceptibility
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component (New Jersey Geologic Survey, 2003, page 123).



Additional information about the results of the *Earthquake Loss Estimation Study for Middlesex County* can be found in Section 7.3 (Risk Assessment) of this Plan.

Severity of the Earthquake Hazard

Although most past earthquakes in northern New Jersey have been of low magnitude, there have been several significant historical events (See Figure 6.3.3-3). As shown in Figure 6.3.3-1, the probability of any severe earthquake in the area is moderate. As discussed in Appendix D, the severity of earthquakes is influenced by several factors, including the depth of the quake, the geology in the area, and the soils. The severity of soil liquefaction is dependent on the soils grain size, thickness, compaction, and degree of saturation[8].

Impact on Life and Property

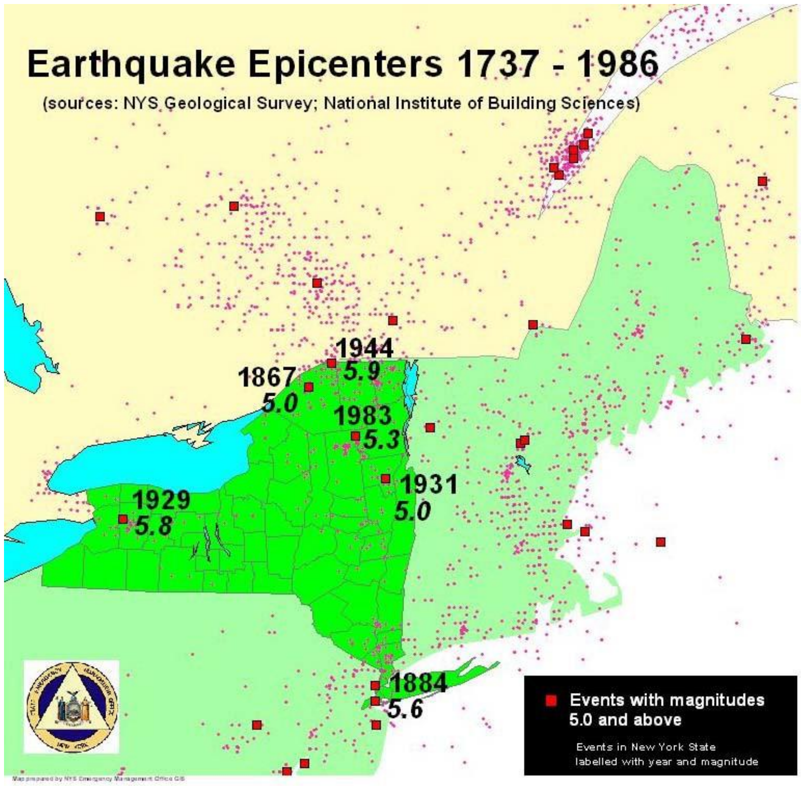
There are no known deaths or injuries from earthquakes in Middlesex County. Some of the past earthquake events were severe enough to cause minor property damage such as broken windows or contents falling from shelves. The effects on life and property in the area could be significant if a large earthquake were to occur, because of the nature of the built environment. However, the very low probability of an event suggests that potential for these impacts is minimal.

Occurrences of the Earthquake Hazard

To identify past earthquake occurrences that have potentially impacted Middlesex County, the map titled *Earthquake Epicenters 1737-1986* displaying historical earthquakes was reviewed. Figure 6.3.3-3 displays historical earthquake epicenters spatially across the Northeast from 1737 to 1986. Although the map highlights historical earthquakes in New York State, the map also shows earthquake occurrences for surrounding States, including northern New Jersey. The map indicates there have been six historical earthquakes of 5.0 magnitude, or greater, within the New Jersey region during the period of record. This map was prepared by the Geographical Information System (GIS) division of the New York State Emergency Management Office (SEMO) using NYS Geological Survey/National Institute of Building Sciences data.

[8] NJGS

Figure 6.3.3-3
Earthquake Epicenters for the Northeast U.S., 1737-1986
(Sources: NYS Geological Survey, National Institute of Building Sciences)



In addition to the *Earthquake Epicenters* map prepared by the New York SEMO, the USGS also offers earthquake history for each State. The USGS earthquake history for New Jersey indicates there have been nine earthquakes statewide since 1927. Of the nine events in New Jersey, the earthquake descriptions provided by the USGS indicate that four have affected Middlesex County. Table 6.3.3-1 below summarizes the past earthquake events that have impacted the planning area.

Table 6.3.3-1:
Middlesex County Earthquake History
(Source: USGS)

Event Date	Epicenter	Description
June 1, 1927	Asbury Park, New Jersey	The highest intensity earthquake ever observed in New Jersey occurred on June 1, 1927, in the Asbury Park area. Three shocks were felt along the coast from Sandy Hook to Toms River. Several chimneys fell, plaster cracked, and articles were thrown from shelves.
September 3, 1951	Rockland County, New York	Northeastern New Jersey experienced minor effects from an earthquake on September 3, 1951 that was apparently centered in Rockland County, New York.

Event Date	Epicenter	Description
March 23, 1957	High Bridge, New Jersey	On March 23, 1957, a shock affected west-central New Jersey, near the site of the 1895 earthquake. Chimneys cracked (intensity VI), windows and dishes broke, and pictures fell at Lebanon. A cracked chimney was also reported from Hamden. At Long Valley some walls were cracked and plaster fell. The felt area was small in comparison with the other shocks previously described.
February 28, 1973	Salem County, New Jersey	Most of New Jersey and adjoining portions of Delaware, Maryland, and Pennsylvania experienced a moderately strong earthquake on February 28, 1973. The magnitude 3.8 tremor was centered in northwestern Salem County, near the Delaware River border with the State of Delaware.

The probability of earthquakes occurring in the future is moderately high, based on previous data. On average, an earthquake has impacted Middlesex County every 20 years. Section 7 of this plan includes a more detailed discussion of the earthquake risk in Middlesex County, including HAZUS based simulation results from the NJGS study, and probability-based risk estimates that were performed using the FEMA Full-Data Earthquake Benefit-Cost Analysis Module.

6.3.4 Erosion

(Including Hurricane / Nor'easter / Coastal Storm)

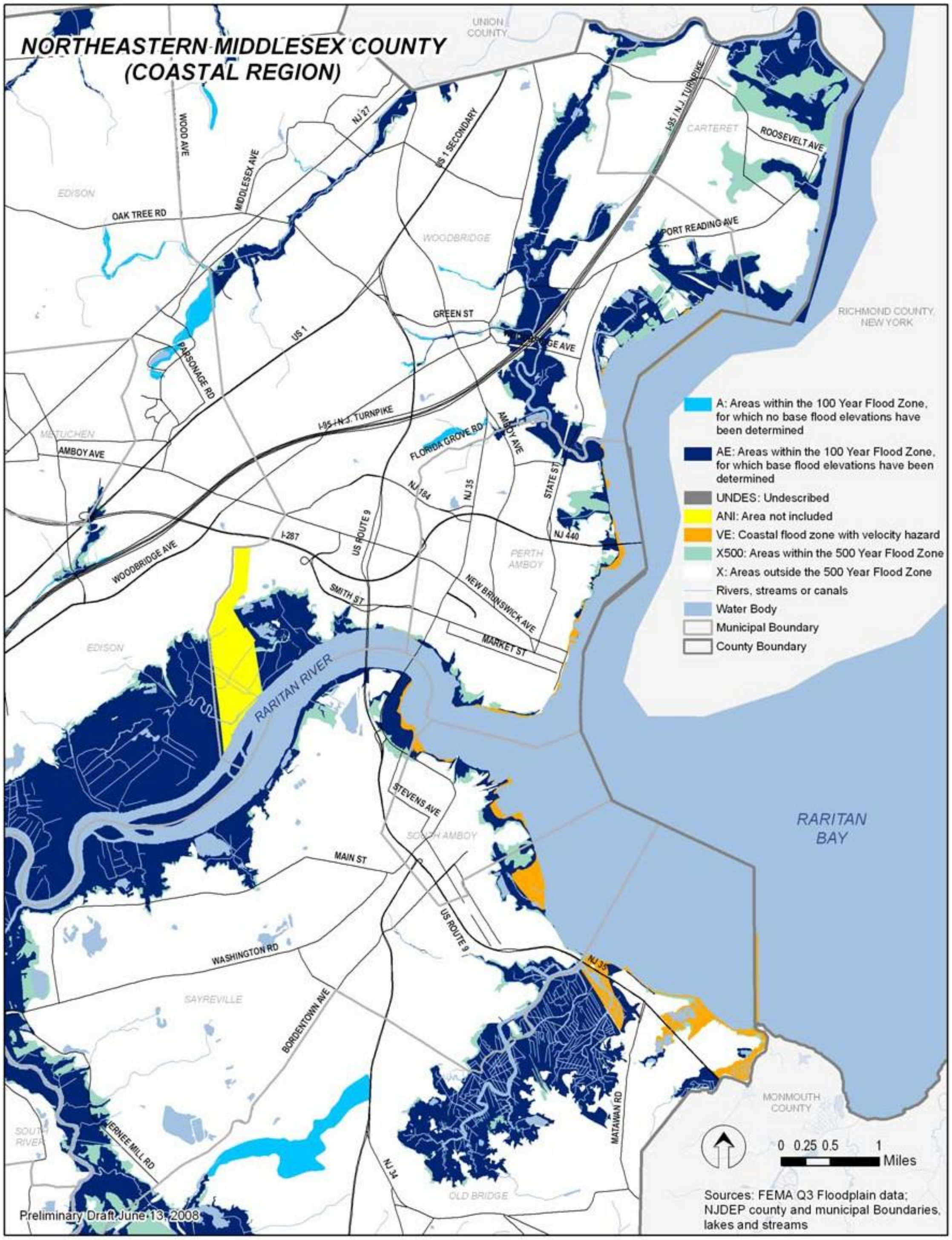
Description of the Erosion Hazard

Coastal erosion is a dynamic process that is constantly occurring at varying rates along the coasts and shorelines of the U.S. Numerous factors can influence the severity and rate of coastal erosion including human activities, tides, the possibility of rising sea levels, and the frequency and intensity of hurricanes. Strong storms and hurricanes can erode large sections of coastline with a single event. The process of coastal erosion results in permanent changes to the shape and structure of the coastline. Human activities such as poor land use practices and boating activities can also accelerate the process of coastal erosion. See Appendix D for a more detailed description and definition of the erosion hazard.

Location of the Erosion Hazard

The State of New Jersey has over 130 miles of coastline, most of which is within close proximity to major metropolitan centers of the mid-Atlantic. Beach restoration and maintenance is an ongoing process for New Jersey. The state legislature provides $25 million annually for beach restoration and every beach on the Atlantic is currently under either a design, engineering or construction phase. In Middlesex County the erosion problem extends along the coast from the Borough of Carteret southward to the northern portion of Old Bridge Township.

Figure 6.3.4-1
Northeastern Middlesex County (Coastal Region)
(Sources: FEMA and NJDEP)



Severity of the Erosion Hazard

Episodic storm erosion generates the most significant erosion along the New Jersey coast. Typically these storms can impact the coast over periods of hours (tropical cyclones) to several days (nor'easters). Although the storm events are short-lived, the resulting erosion can be equivalent to decades of long-term coastal change. The actual quantity of sediment eroded from the coast is a function of storm tide elevation relative to land elevation, the duration of the storm and the characteristics of the storm waves. During severe coastal storms, it is not uncommon for the entire berm and part of the dune to be removed from the beach. The amount of erosion is also dependent on the pre-storm width and elevation of the beach. If the beach has been left vulnerable to erosion due to the effects of recent storms, increased erosion is likely. The time necessary for the beach to naturally recover from significant erosion can often be on the order of years to decades.

Impact on Life and Property

Erosion from coastal storms has the potential to cause significant property damage particularly to more densely populated beach communities that are directly exposed to the Atlantic coast. Potentially billions of dollars of coastal development may be damaged or destroyed by the effects of erosion. Additionally the loss of beach shoreline can also have a negative impact on a community due to the potential loss of tourism dollars.

The coastal erosion problem is studied by various Federal, State and local agencies and organizations. The New Jersey Beach Profile Network (NJBPN) has been monitoring and surveying beach erosion along the New Jersey coastline since 1986. The survey data produced by the NJBPN includes cross-sectional profiles and quantitative measurements of volumetric changes along the profiles over time.

Occurrences of the Erosion Hazard

Table 6.3.4-1 highlights some of the major events that have caused coastal erosion in Middlesex County. In addition to these larger events described below, minor coastal erosion occurred from storm events in 1994, 1998, and 2002.

Table 6.3.4-1:
Major Coastal Erosion Events impacting Middlesex County (1990 – 2007)
(Sources: FEMA, NOAA/NCDC)

Event date & Disaster (DR)	Erosion Event
12/1992 (DR-973)	SEVERE STORMS AND INLAND AND COASTAL FLOODING – A major winter storm (Nor'easter) that caused considerable coastal flooding and beach erosion. A total of 12 counties in NJ included as part of the Presidentially Declared Disaster.
3/16/1993 (DR-3106)	SEVERE STORMS AND INLAND AND COASTAL FLOODING – Event know as the "Storm of the Century" affected as many as 26 States from Florida to Maine, the Gulf Coast, and the Ohio Valley. One of the most intense nor'easters to ever effect the United States caused moderate coastal erosion along the New Jersey coastline. All 21 counties in New Jersey were included in the Presidentially Declared Disaster.
2/12/2006	SEVERE STORMS AND INLAND AND COASTAL FLOODING – A major winter storm (Nor'easter) that impacted the New Jersey shoreline with strong onshore winds that caused coastal flooding and beach erosion. In Middlesex County the area of South Amboy was impacted by coastal flooding.

Event date & Disaster (DR)	Erosion Event
9/1/2006	TROPICAL STORM ERNESTO – The combination of the remnants of Tropical Storm Ernesto and a large high pressure system over eastern Canada produced heavy rain, tidal flooding, and beach erosion in New Jersey. In Middlesex County erosion along the coast was widespread. In South Amboy sand eroded away from underneath the sidewalk at the Waterfront Park.
4/15/2007 (DR 1694)	SEVERE STORMS AND INLAND AND COASTAL FLOODING – A 7-day Nor'easter deluged New Jersey with over 9 inches of rain, causing millions of dollars of damage and killing three residents. In Middlesex nearly every municipality suffered flood damages or roads closed due to the extensive flooding.
11/3/2007	HURRICANE NOEL – The remnants of Hurricane Noel caused strong winds, minor tidal flooding and beach erosion along the New Jersey coast. In Middlesex County, in Old Bridge a four foot high dune was cut at its base for one-quarter of a mile from the municipal building to the police station.

As mentioned above, the coastal erosion problem is an ongoing problem along many areas of the Middlesex County coastline. It is difficult, if not impossible, to assign a probability to the near constant small ongoing erosion that may occur over a continuous period of time. However, a probability can be assigned to larger storm events such as nor'easters, hurricanes and coastal storms which can result in significant storm induced coastal erosion.

As shown above in Table 6.3.4-1, there were six major nor'easters or downgraded hurricanes that caused erosion in Middlesex County between 1990 and 2007. This translates to about one event every three years. In addition to the larger events noted above smaller nor'easters and other coastal storms cause erosion along the county coastline on average one to two times per year. The period of time over which this data is provided suggests the probability of coastal erosion will be about the same in the future, with year-to-year variations.

6.3.5 Extreme Temperature - Cold

Description of the Extreme Temperature (Cold) Hazard

Temperatures that are significantly below normal are considered extreme cold temperatures. The consequences of extreme cold on humans are intensified by high winds which increase the rate of heat loss and has the effect of making it feel colder than the actual air temperature. Extreme cold temperatures combined with high winds can lead to frostbite, permanent damage to the body, or even death. See Appendix D for a more detailed description and definition of the extreme cold hazard.

Location of the Extreme Temperature (Cold) Hazard

The entire planning area is subject to the hazards associated with extreme cold temperatures.

Severity of Extreme Temperature (Cold)

The severity of extreme cold temperature events are measured by temperature, duration and humidity. Most events are of less than a week in duration but can occasionally last for longer periods up to several weeks.

Impact on Life and Property

The structure of the NCDC database combines the extreme cold and extreme heat into temperature extremes. The database indicates there have been one death and seven injuries from one extreme cold event that occurred from January 13 – 29, 2003. During this event low temperatures were reported near or below zero. In Middlesex County a 20-year-old man was found frozen to death at a Garden State Parkway rest stop in Woodbridge. Damages from extreme cold temperatures are generally confined to effects on humans (described above), although occasionally there may be relatively minor effects on infrastructure such freezing pipes or electric grids.

Table 6.3.5-1 lists the extreme temperature events from the NCDC that have resulted in injuries or death in Middlesex County. Periodically throughout Section 6.3, the output from the NCDC database queries has been included to summarize past events for specific hazards.

Table 6.3.5-1:
Reported Deaths and Injuries from Temperature Extremes, Middlesex County, 1950 – 2007
(Source: NOAA/NCDC)

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 NJZ009>010 - 012>013 - 015 - 020>026	06/25/1997	09:00 AM	Excessive Heat	N/A	0	4	0	0
2 NJZ001 - 007>010 - 012>026	07/12/1997	10:00 AM	Excessive Heat	N/A	0	25	0	0
3 NJZ008>010 - 012>022	06/25/1998	09:00 AM	Excessive Heat	N/A	0	20	0	0
4 NJZ001 - 007>010 - 012>026	07/04/1999	08:00 AM	Excessive Heat	N/A	17	160	0	0
5 NJZ001 - 007>010 - 012>027	01/14/2003	03:00 AM	Extreme Cold/wind Chill	N/A	1	7	0	0
6 NJZ007>010 - 012>027	08/01/2006	09:00 AM	Excessive Heat	N/A	0	41	0	0
				TOTALS:	18	257	0	0

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query.

Several of the column headings (the five farthest to the right) within the NCDC table above have been abbreviated and are defined as follows:

- Mag = Magnitude of the event for applicable hazards (Hailstorms, Tornadoes, etc.)
- Dth = Number of deaths
- Inj = Number of Injuries
- PrD = The dollar amount of reported property damage
- CrD = The dollar amount of reported crop damage

Occurrences of Extreme Temperature (Cold)

The NCDC database indicates there have been six recorded extreme cold temperature events in Middlesex County during the period 1950 – 2007. As shown in Table 6.3.5-1 above, one of these events was severe enough to result in seven injuries and one death. The database includes other "unseasonably" cold events, but these were excluded from the total, only counting the extreme cold events. On average, an extreme cold temperature event occurs approximately once every 10 years. Based on the historical data from the NCDC database, the probability of future extreme cold temperature events is relatively low.

6.3.6 Extreme Temperature - Heat

Description of the Extreme Temperature (Heat) Hazard

Temperatures that are significantly above normal are considered extreme temperatures. Heat stress can be indexed by combining the effects of temperature and humidity. See Appendix D for a more detailed description and definition of the extreme heat hazard.

Location of the Extreme Temperature (Heat) Hazard

The entire planning area is subject to the hazards associated with extreme high temperatures.

Severity of Extreme Temperature (Heat)

The severity of extreme temperature events are measured by temperature, duration and humidity. Most events are less than a week in duration. In the northeastern United States, periods of warmer than normal temperatures typically occur several times a summer. Extreme heat waves may occur about once every five years or so where maximum daily temperatures exceed 100 degrees Fahrenheit for an extended period of time. The passing of a cold front usually moderates temperatures after a few days to a week.

Impact on Life and Property

The structure of the NCDC database combines the extreme cold and extreme heat into temperature extremes. The database indicates there have been 17 deaths and 250 injuries from excessive heat-related events. Of the 18 reported deaths 17 were from one event that occurred from July 4 - 6, 1999. From the description provided in the NCDC database, the 17 deaths appear to cover all parts of New Jersey impacted by the event. In Middlesex County four deaths occurred. The combination of the temperature and humidity produced heat indices of around 110 degrees Fahrenheit during the afternoon of each day. Most of the deaths occurred to elderly persons in poor health, with no air-conditioning and inadequate ventilation. In addition to the four deaths, 160 people were injured. Damages from the extreme temperature hazard are generally confined to effects on humans, although occasionally there may be relatively minor effects on infrastructure such as electric grids.

Table 6.3.6-1:
Reported Deaths and Injuries from Temperature Extremes, Middlesex County, 1950 – 2007
(Source: NOAA/NCDC)

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 NJZ009>010 - 012>013 - 015 - 020>026	06/25/1997	09:00 AM	Excessive Heat	N/A	0	4	0	0
2 NJZ001 - 007>010 - 012>026	07/12/1997	10:00 AM	Excessive Heat	N/A	0	25	0	0
3 NJZ008>010 - 012>022	06/25/1998	09:00 AM	Excessive Heat	N/A	0	20	0	0
4 NJZ001 - 007>010 - 012>026	07/04/1999	08:00 AM	Excessive Heat	N/A	17	160	0	0
5 NJZ001 - 007>010 - 012>027	01/14/2003	03:00 AM	Extreme Cold/wind Chill	N/A	1	7	0	0
6 NJZ007>010 - 012>027	08/01/2006	09:00 AM	Excessive Heat	N/A	0	41	0	0
				TOTALS:	18	257	0	0

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

Occurrences of Extreme Temperature (Heat)

The NCDC database indicates there have been 10 recorded extreme temperature events related to high heat in Middlesex County during the period 1950 – 2007. The database includes other "unseasonably" warm events, but these were excluded from this total. Events that were listed for consecutive months were combined into single events. On average, an extreme heat event occurs approximately once every six years. Based on the historical data from the NCDC database, the probability of future extreme heat events is likely to occur but with relatively minor impacts on life and property.

As mentioned above, one of the worst extreme heat-related events occurred in July, 1999. A very strong and oppressive high pressure system resulted in a brutal heat wave in New Jersey that included the entire Independence Day weekend. High temperatures reached the 90s for the first time on the 3rd, but sweltering humidity and record breaking maximum temperatures of around 100 degrees occurred from Independence Day through the July 6th [9].

6.3.7 Flood

(Includes Tidal, Flash, and Riverine Flooding)

Description of the Flood Hazard

Flooding is defined as the accumulation of water within a water body and the overflow of excess water onto adjacent floodplain lands. The floodplain is the land adjoining the channel of a river, stream, ocean, lake, or other watercourse or water body that is susceptible to flooding.

[9] NOAA/NCDC database

Hundreds of floods occur each year in the United States, including overbank flooding of rivers and streams and shoreline inundation along lakes and coasts. Flooding typically results from large-scale weather systems generating prolonged rainfall. Flooding in Middlesex County can be the result of the following weather events: hurricanes, thunderstorms (convectional and frontal), storm surge or winter storms. See Appendix D for a more detailed description of the flood hazard.

Location of the Flood Hazard

Numerous areas within Middlesex County are susceptible to localized flooding from excess rain events, stormwater runoff, local drainage problems, overbank flooding and other sources. All of the municipalities within the County experience some degree of flooding. This section highlights several of the significant flood areas throughout Middlesex County.

Figure 6.3.7-1 is a map displaying the different flood zones found throughout Middlesex County (see flood zone descriptions following the map). The flood zones displayed on the map below (and all other floodplain maps in Sections 6 and 7) are based on FEMA Q3 data, the most current floodplain data available at the time the Plan was prepared in June, 2008. The 100-year floodplain includes areas with a one percent annual chance of flooding and includes zones A and AE. In Figure 6.3.7-1 the AE zone is shaded dark blue and the A zone shaded light blue. The majority of the 100-year floodplain areas roughly follow the major rivers in Middlesex County including the Raritan River and its tributaries, the Woodbridge River, and the Arthur Kill River. The 500-year floodplain includes areas with a 0.2 percent annual chance of flooding. The flood zone X500 is shown on the map below in green and represents the areas between the limits of the 100-year floodplain (1% annual chance flooding) and 500 year floodplain (0.2% chance flooding). The un-shaded area (zone X), is considered outside of the 500-year floodplain.

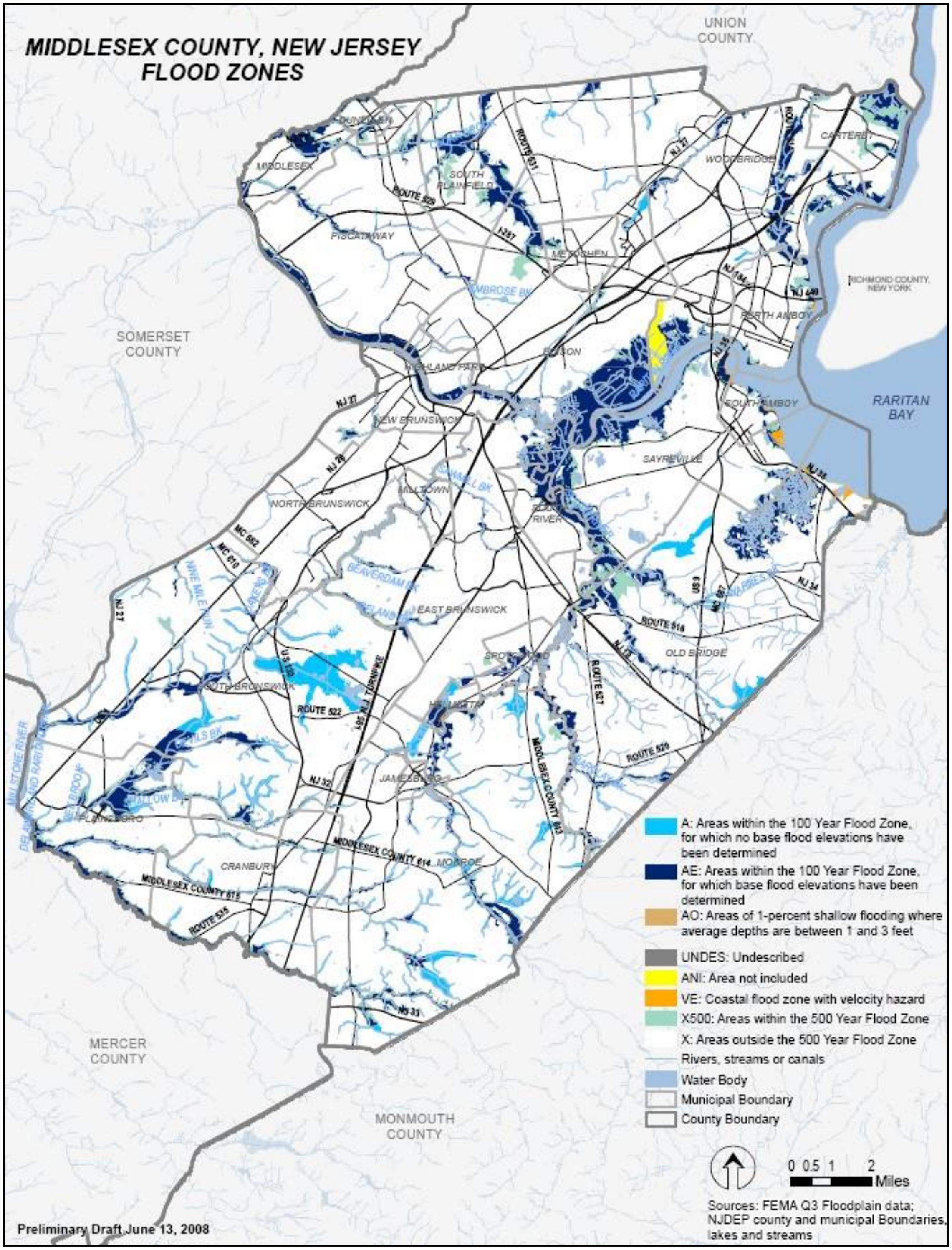
The map shows the coastal area near South Amboy is susceptible to high velocity flooding (flood zone VE) from storm surge events. This area is shaded purple on the map. Flooding within this area is predominately from storm surge and covered in Section 6.3.17 of this plan.

FEMA Digital Flood Maps and Data

Flood mapping and analyses in Sections 6 and 7 of this Plan utilized FEMA Q3 floodplain data. This data was secured from NJDEP prior to undertaking the flood profiling and risk assessment studies in Sections 6 and 7. The flood analysis in Section 6 was completed in the Spring of 2008 (Note: This corresponds to the “Preliminary Draft – June 13, 2008” notation in the lower corner of figures in Sections 6 and 7, and “Preliminary Draft – May 27, 2008” in some figures in Section 7). In early 2008 when the data was obtained by JLWA, NJDEP indicated this was the most current information available.

Subsequently, Figure 9.4-1 was added to Section 9 as part of Plan updates in the Spring of 2009 using preliminary DFIRM information provided by NJDEP that became available in September 2008. Since that time, DFIRM mapping for Middlesex County has been approved effective July 6, 2010. Action Item 2.A.4 in Table 9.3.2-1 indicates that DFIRM mapping will be incorporated into future updates of the Plan.

Figure 6.3.7-1
Floodplain Map of Middlesex County
(Sources: FEMA and NJDEP)

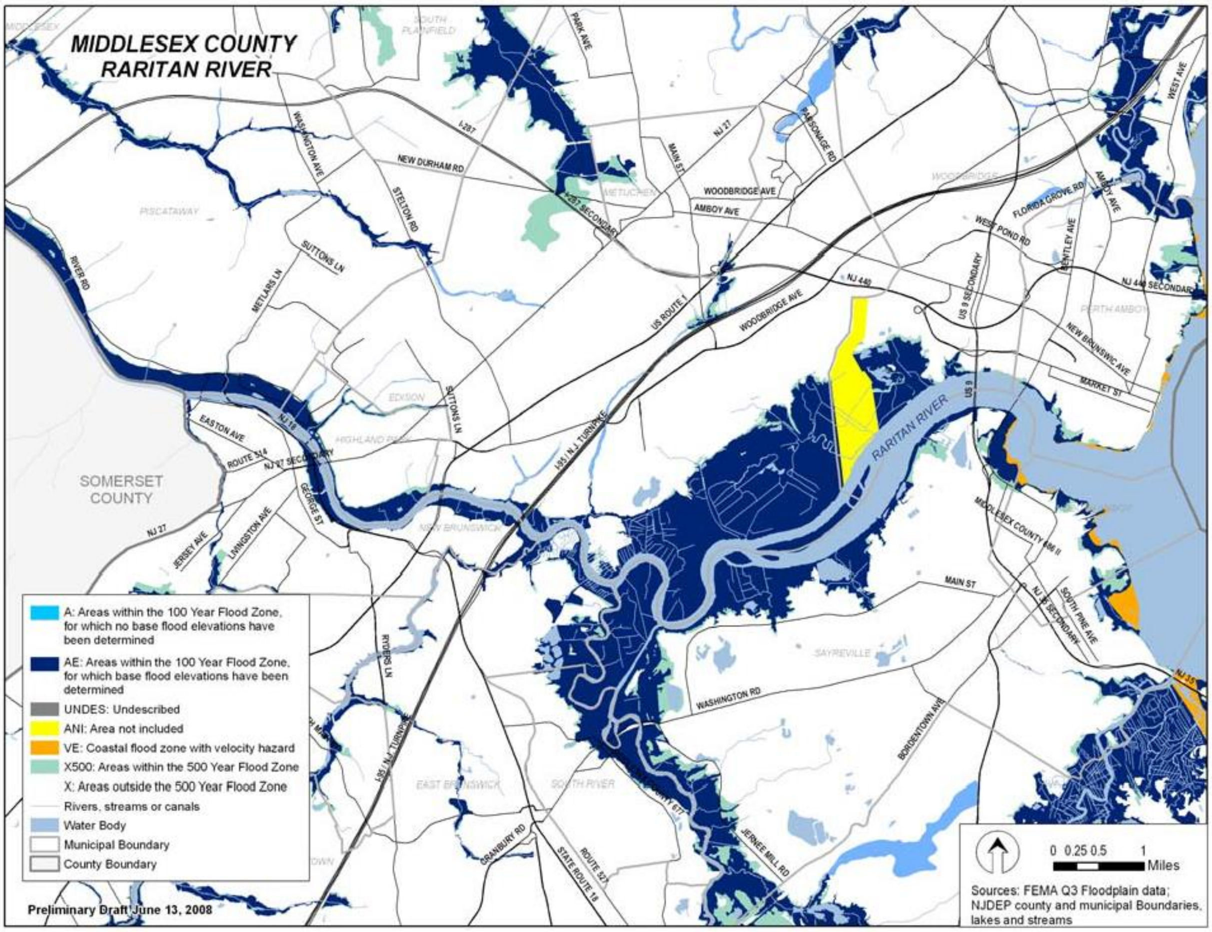


The flood zone designations are defined as follows:

- **Zone A (1 % annual chance of flooding).** Shaded light blue. Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
- **Zone AE (1 % annual chance of flooding).** Shaded dark blue. Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
- **Zone AO (1 % annual chance of flooding).** Shaded tan. River or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Average flood depths derived from detailed analyses are shown within these zones.
- **X500 (0.2 % annual chance of flooding).** Shaded green. Represents areas between the limits of the 1% annual chance flooding and 0.2% chance flooding
- **Zone X.** Unshaded area. Areas outside the 1% annual chance floodplain and 0.2 percent chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone (Source: FEMA).
- **Zone VE.** Shaded orange. Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
- **UNDES.** Shaded gray. Un-described. No information available.
- **ANI.** Shaded yellow. Areas located within Middlesex County that are not mapped on any published FIRM.

The County is roughly bisected southwest to northeast by the Raritan a major river in central New Jersey. The watershed of the Raritan River collects most of the runoff from the mountainous areas of the central portion of the State. The Raritan forms just west of Somerville, New Jersey and empties into the western edge of Raritan Bay along the Atlantic Ocean. In the past, the Raritan River has experienced significant flooding problems when excessive rain from storms affects the river basin. Figure 6.3.7-2 is a map of the Middlesex County portion of the Raritan River with the 100-year floodplain shaded dark blue and aqua.

Figure 6.3.7-2
Middlesex County Portion of the Raritan River
(Sources: FEMA and NJDEP)



In the northeast part of the county, portions of the Woodbridge River Basin area are vulnerable to flooding. Other areas of the County that are susceptible to flooding include the Helmetta, Jamesburg, and Spotswood areas. In 2005 the County formed a Flood Control Commission to address the flooding in Helmetta, Jamesburg, and Spotswood. The flooding problem in these areas is described in the following subsection. The specific causes and effects of flooding from the Raritan and Woodbridge Rivers are discussed in more detail in Section 7 (Risk Assessment).

Raritan River Floodplain

Certain areas of the Raritan River are susceptible to overbank flooding. In the past there have been repeated flood events along certain parts of the River. Portions of the Raritan River have seen major flooding events in 1996, 1999, and 2007.

The flooding event on October 19th, 1996 caused an estimated $2.7 million in damages throughout Middlesex County. A Federal Disaster Declaration (DR-1145) was declared in five New Jersey counties, including Middlesex. In Dunellen the damages were estimated at $500,000 including 20 residential homes that were damaged by flooding from the Raritan River. Of the 20 homes damaged, floodwaters caused serious structural damage to about half including one that was moved from its foundation[10] .

In the fall of 1999 Hurricane Floyd caused widespread damage from South Carolina to as far north as Maine. The storm had been downgraded by the time it reached New Jersey but still dumped as much as nine inches of rain on parts of the state causing flooding along the Raritan. A total of 12 counties in New Jersey received a Presidential declaration (DR-1295). The total estimated FEMA Public Assistance was just over $2.3 million.

In neighboring Somerset County the communities of Bound Brook and Manville suffered severe flooding from the Raritan River. In Middlesex County overbank flooding from the Raritan caused significant flooding in New Brunswick and other communities along the River flowing out to the Raritan Bay. As the Raritan River was rising, the incoming high tide during the early morning of the 17th prevented it from discharging into the bay. The floodwaters caused an estimated $6 million in damages to 500 homes in Middlesex Borough. In Woodbridge, flooded stores were not expected to be reopened for weeks. In Piscataway where damage estimates reached $5 million, the Riverside, Mayflower and Birchview Apartment Complexes were severely flooded. Parks near the Raritan River were also badly damaged[11].

In Edison, low water pressure problems associated with the Elizabethtown Water Treatment Plant resulted in little or no water for the township for the first four days following the event. During this time the National Guard provided water for the township. Numerous streams flooded throughout the county and by the afternoon of the September 19th an estimated 30 to 40 roads throughout the county were already closed with numerous water rescues from car tops taking place. In Dunellen over 100 homes were damaged by flooding[12].

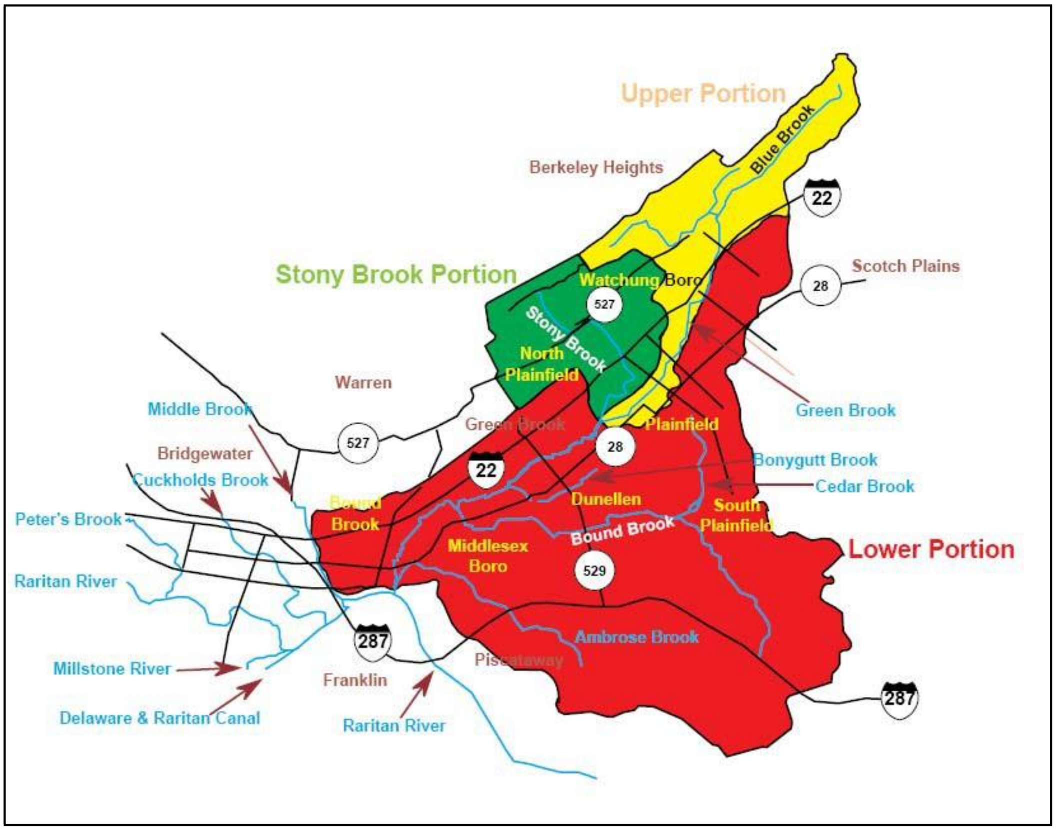
The New Brunswick area flooded again as a result of overbank flooding from the Raritan during the April 2007 flood event. Parts of Route 18 were closed due to the flooding.

Figure 6.3.7-3
Raritan River flooding in New Brunswick, NJ; April 2007 Flood Event
(Source: The Star-Ledger; April 16, 2007)

[10] NOAA/NCDC Database
[11] NOAA/NCDC Database
[12] NOAA/NCDC Database

In the northwestern portion of Middlesex County the Raritan and its tributaries flow through Middlesex Borough, Dunellen and Plainfield. This portion of the county is part of the Green Brook Sub Basin which covers an area 65 square miles and includes portions of three counties and 13 municipalities. In the past, the Green Brook Sub Basin has experienced severe and sometimes devastating flood damages. The U.S. Army Corps. of Engineers (USACE) – New York District has studied this area extensively in the past and has completed several flood control projects within the Basin with additional projects currently in progress. Figure 6.3.7-4 is a map which divides the basin into three areas; Upper Portion, Stony Brook Portion, and the Lower Portion. The majority of the Lower Portion is within Middlesex County and has been impacted in the past by major flood events in 1973, 1996, and 1999[13].

Figure 6.3.7-4
Green Brook Sub Basin: Upper Portion, Stony Brook Portion, and the Lower Portion
(Source: USACE – New York District)



Woodridge River Basin

The Woodridge River Basin, located in northeast Middlesex County, has been a major cause of flood problems. The watershed is approximately five miles in length from its headwaters, or the upper portion of the river, located in the northeastern corner of Woodbridge Township near the Carteret/Rahway Township line to its mouth at the Arthur Kill River.

[13]USACE – New York District

Within the Basin there are several areas that are particularly prone to flooding including the area between the New Jersey Turnpike (Interstate 95) and Port Reading Avenue, and along the Woodbridge River from the Port Reading railroad north to Crampton Ave. Flooding in these areas is mainly associated with storm tides. The Crampton Avenue neighborhood and the Rahway Ave Mobile Home Park are considered the most flood prone communities within Basin.

In the past, the Woodridge River Basin has experience numerous significant flood events which have resulted in damages to both residential homes and public infrastructure. The storm event in October 1996 damaged over 170 homes near Crampton Avenue and the Rahway Avenue Mobile Home Park, and totaled approximately $600,000 in damages. This area has been studied extensively in the past by the USACE – New York District. In 1999 the New York District completed a reconnaissance study of this area. In 2007, the New York District initiated the Woodbridge River Basin Flood Damage Reduction and Ecosystem Restoration Study to identify possible flood control and ecosystem restoration measures within the Basin[14] .

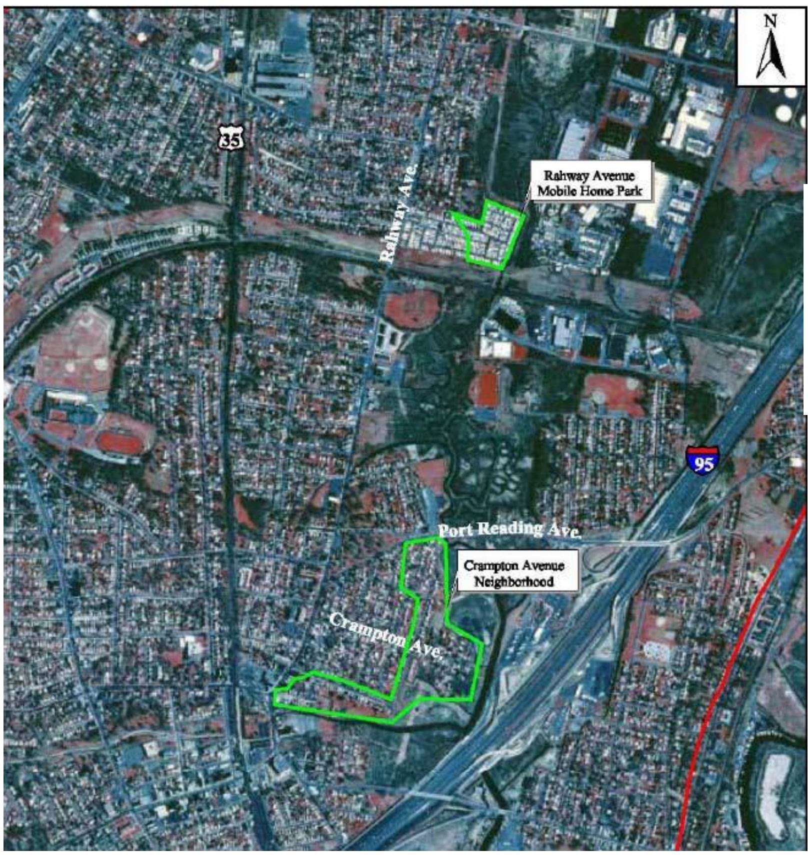


Figure 6.3.7-5
Map of the Crampton and Rahway Avenue Neighborhoods in Woodbridge, NJ

(Source: Flood Damage Reduction and Ecosystem Restoration Study – August 2007)

[14] Flood Damage Reduction and Ecosystem Restoration Study – August 2007

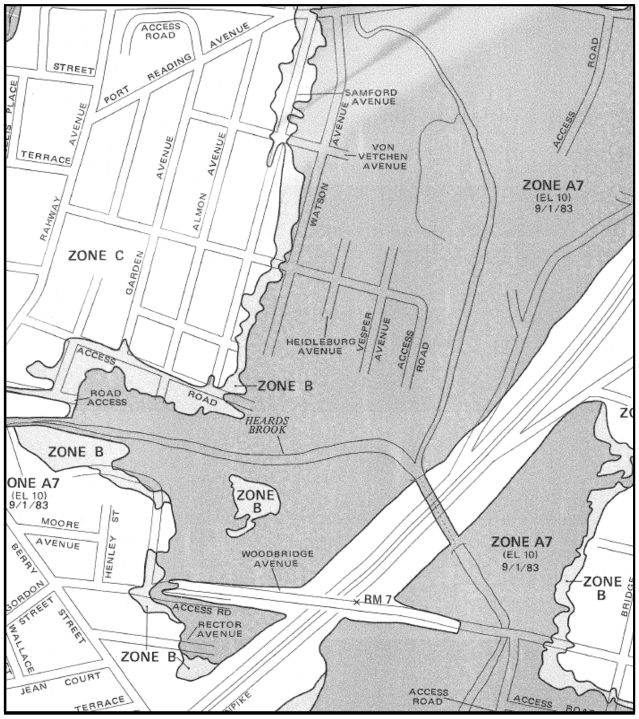


Figure 6.3.7-6
FIRMette of Woodbridge River area west of Interstate 95, New Jersey

(Source: FEMA Map Service Center)

Helmetta, Jamesburg, Spotswood area Flooding

In September of 2005 the County created the South Central Middlesex County Flood Control Commission to address the problem of flooding in the Helmetta, Jamesburg, and Spotswood area. The commission was formed after the July 2005 flood event and is studying a 44 square mile area. Half of the study area is in Middlesex County and other half in Monmouth County[15] .

The July 2005 flood event caused significant flooding in the towns of Helmetta, Jamesburg, Spotswood, and other surrounding areas. In these three towns floodwaters from the event inundated and damaged a total of 440 residential homes and 20 businesses. In Jamesburg a total of 7-8 inches of rain fell within a period of several hours. The excess rainfall in such a short period of time resulted in flash flooding in Jamesburg that inundated approximately 75 residential homes and 12 businesses causing an estimated $3.4 million in damages. Flooded areas within the City included West Railroad Avenue, East Church Street, Pergola Avenue, Willow Street, Forsgate Drive, and Gatmzer Avenue[16]. The storm also caused significant infrastructure damages in Jamesburg including a 60 inch drainpipe that collapsed near the intersection of Forsgate Drive and West Railroad Avenue. The collapsed drainpipe created a 20 foot sinkhole undermining the roadway and causing an estimated $600,000 in damages[17] . In Spotswood and Helmetta the damages from the event were estimated at $2.2 million and $750,000 respectively [18].

[15] Sentinel News – September 1, 2005
[16] Jamesburg.net
[17] Middlesex County – Engineering Department
[18] Sentinel – July 28, 2005

Figure 6.3.7-7
Jamesburg, New Jersey during the July 2005 Floods
(Source: Jamesburg.net/flood2005)

Severity of the Flood Hazard

Floods have been and continue to be the most frequent, destructive, and costly natural hazard facing Middlesex County. Ninety-five percent of the county's damage reported for major disasters is associated with floods. Most recently, the county has been impacted by six significant flood events: in 1996, 1999, 2003, 2005, 2006, and 2007. Flood severity is measured in several ways, including frequency, depth, velocity, duration and contamination, among others. In Middlesex County, characterizing the severity of the flood hazard depends on what part of the county is being considered, but generally speaking the issues relate to how often floods occur.

Impact on Life and Property

The NCDC database indicates that there have been 47 floods in Middlesex County in the period from 1950 to 2007, with damages of over $42 million. Figures maintained by NCDC indicate that Middlesex County has experienced one death and 72 injuries due to floods. Of those 73 injuries, NCDC reported 72 injuries related to flooding from Hurricane Floyd in 1999[19] . Section 7 of this plan includes a much more detailed discussion of flood impacts on the county, in particular the history of National Flood Insurance Program claims, and the number of FEMA "repetitive loss" properties.

Occurrences of the Flood Hazard

The table below highlights past flood events that have resulted in property damage in Middlesex County. The NCDC database indicates that five floods between 1996 and 2006 have resulted in property damage.

[19] NOAA/NCDC database

Table 6.3.7-1:
Flood Events Resulting in Property Damage, Middlesex County, 1950 – 2007
(Source: NOAA/NCDC)

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Countywide	10/19/1996	01:00 PM	Flash Flood	N/A	0	1	2.7M	0
2 Countywide	09/16/1999	09:00 AM	Flash Flood	N/A	0	72	28.0M	0
3 Northwest Portion	08/05/2003	02:00 PM	Flash Flood	N/A	0	0	250K	0
4 Southeast Portion	07/17/2005	03:00 PM	Flash Flood	N/A	0	0	10.3M	0
5 NJZ012>014 - 020 - 022>027	02/12/2006	06:00 AM	Coastal Flood	N/A	0	0	900K	0
				TOTALS:	0	73	42.150M	0

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

In addition to the events listed in the NCDC database, two other flood events have also resulted in property damage. Flooding events have occurred in 1996, 1999, 2003, 2005, 2006, and 2007. These events are summarized in Table 6.3.7-2. Federally Declared events are indicated by the disaster number (DR).

Table 6.3.7-2:
Description of Flood Events Resulting in Property Damage, Middlesex County, 1996 – 2007
(Sources: FEMA, NOAA/NCDC)

Event & Date	Flood Description
10/19/96	Flash Flood – The flash flooding event caused an estimated $2.7 million in damages in Middlesex County. Flooding temporarily closed parts of US 1 and 9, several State routes, and the Garden State Parkway. In Dunellen 20 homes were damaged by the floodwaters.
9/16/99 (DR 1295)	HURRICANE FLOYD – This downgraded fall hurricane put the entire Eastern Seaboard on flood watch, including every county in New Jersey. The storm lasted approximately 18 hours and caused an estimated $3.5 million in damages to public infrastructure in Middlesex County. In Middlesex, floodwaters from the Raritan River caused severe flooding. As the Raritan River was rising, the incoming high tide during the early morning of the 17th prevented it from discharging into the bay. A total of 500 homes were damaged in Middlesex Borough. Residential damages were estimated at $6 million.
8/5/03	SEVERE STORMS AND FLOODING – Thunderstorms with heavy rains caused flooding in the northwest part of the County. Rainfall totals from the storm were estimated at 2-5 inches and resulted in $250,000 in damages.
7/17/05	SEVERE STORMS AND FLOODING – Flash flooding occurred in the Manalapan Brook Basin in southeastern Middlesex County impacting seven municipalities; East Brunswick, Jamesburg, Monroe, Spotswood, Helmetta, South River and Old Bridge. Collectively the flood damages to these areas totaled $9.7 million. A total of 308 homes, 25 apartments, 20 businesses and one industrial facility were damaged
2/12/2006	SEVERE STORMS AND INLAND AND COASTAL FLOODING – A major winters storm that impacted the New Jersey shoreline with strong onshore winds that caused coastal flooding and beach erosion. In Middlesex County the area of South Amboy was impacted by coastal flooding.

Event & Date	Flood Description
4/15/07 (DR 1694)	SEVERE STORMS AND INLAND AND COASTAL FLOODING – A seven-day Nor'easter deluged New Jersey with over nine inches of rain, causing millions of dollars of damage and killing three residents. In Middlesex County nearly every municipality suffered flood damages or roads closed due to the extensive flooding.

National Flood Insurance Program (NFIP) information provides an indication of the potential for flooding in Middlesex County, and the amount of damage it has caused in the past. Review of prior NFIP flood claims can also help reveal areas of the county that are vulnerable to damages from flooding. In recent years, FEMA has focused considerable attention on these insured, repetitive loss properties. By NFIP standards, these properties had to have received two or more claim payments of at least $1,000 each over a ten-year period. In Middlesex County, 202 residential and commercial properties have been identified as repetitive loss properties. Collectively, claim holders have received payments of over $9.7 million (includes claim payments for building damage and contents damage).

Based on past and recent history, certain parts of Middlesex County clearly have a high probability of flooding repeatedly in the future. Several areas adjacent to the Raritan River and within the Woodbridge River Basin area of the County have flooded several times in the past few years. Severe flooding in Middlesex County six out of the last twelve years and each of the past three years suggests that the repeated flooding in certain areas may continue.

6.3.8 Hail

Description of the Hail Hazard

Hail is a form of precipitation comprised of spherical lumps of ice. Known as hailstones, these ice balls typically range from 5 mm–50 mm in diameter on average, with much larger hailstones forming in severe thunderstorms. The size of hailstones is a direct function of the severity and size of the storm. See Appendix D for a more detailed description and definition of the hail hazard.

Location of the Hail Hazard

Hailstorms occur more frequently during the late spring and early summer, when the jet stream migrates northward across the Great Plains. This period has extreme temperature changes from the ground surface upward into the jet stream, which produces the strong updraft winds needed for hail formation. The land area affected by individual hail events is not much smaller than that of a parent thunderstorm, an average of 15 miles in diameter around the center of a storm.

The potential for hail exists over the entire planning area, although the probability is relatively low compared to other parts of the United States. There are at least a few incidences of hail almost every year in the planning area, although for the most part they are minor.

Severity of the Hail Hazard

The severity of hailstorms is measured by duration, size of the hail itself, and geographic extent. All of these factors are directly related to the weather phenomena that create the hail, thunderstorms. There is wide potential variation in these severity components. The planning area has a relatively low potential for significant hail events, based on previous records.

Impact on Life and Property

There are no known instances of injuries or death from hail events in Middlesex County. The NCDC database indicates only one event in 2003 caused $10,000 in property damage. Presumably there are additional damages, but most of these are likely addressed by citizens or insurance companies, and therefore there is no readily accessible record of damages. Damages that do occur are presumably orders of magnitude less than other hazards such as floods or hurricane winds.

Occurrences of the Hail Hazard

The National Climatic Data Center reported 22 hail events from the period 1950 through 2007 in Middlesex County. Hailstone sizes from the 22 events ranged in diameter from .75 inches to 1.75 inches. Beginning with the 1996 event, the NCDC database identifies the municipality within the county where the event occurred. Table 6.3.8-1 summarizes all Middlesex County hail events.

Table 6.3.8-1:
Hail Events, Middlesex County, 1950 – 2007
(Source: NOAA/NCDC)

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 MIDDLESEX	08/05/1967	1805	Hail	0.75 in.	0	0	0	0
2 MIDDLESEX	06/24/1985	1330	Hail	0.75 in.	0	0	0	0
3 MIDDLESEX	07/08/1987	2250	Hail	1.00 in.	0	0	0	0
4 MIDDLESEX	07/30/1987	1535	Hail	1.00 in.	0	0	0	0
5 MIDDLESEX	09/22/1987	1500	Hail	0.75 in.	0	0	0	0
6 MIDDLESEX	07/05/1990	1325	Hail	1.75 in.	0	0	0	0
7 MIDDLESEX	07/07/1991	1045	Hail	1.00 in.	0	0	0	0
8 Cranbury	06/12/1996	05:40 PM	Hail	1.00 in.	0	0	0	0
9 Woodbridge	07/03/1996	03:37 PM	Hail	0.75 in.	0	0	0	0
10 East Brunswick	07/14/1996	05:45 PM	Hail	0.75 in.	0	0	0	0
11 Fords	08/05/1997	07:30 PM	Hail	0.75 in.	0	0	0	0
12 Carteret	06/20/1998	04:15 PM	Hail	1.75 in.	0	0	0	0
13 Sayreville	09/07/1998	01:20 PM	Hail	0.88 in.	0	0	0	0
14 Highland Park	05/24/2000	05:00 PM	Hail	0.75 in.	0	0	0	0
15 Deans	03/21/2003	04:53 PM	Hail	0.88 in.	0	0	0	0
16 Middlesex	03/21/2003	05:10 PM	Hail	1.75 in.	0	0	10K	0
17 New Brunswick	05/28/2003	03:13 PM	Hail	0.75 in.	0	0	0	0
18 Metuchen	07/22/2003	01:15 PM	Hail	0.75 in.	0	0	0	0
19 Milltown	07/22/2003	03:30 PM	Hail	1.75 in.	0	0	0	0
20 South Plainfield	05/12/2004	03:12 PM	Hail	1.00 in.	0	0	0	0
21 Monmouth Jct	05/24/2004	06:40 PM	Hail	1.00 in.	0	0	0	0
22 North Brunswick	05/24/2004	06:55 PM	Hail	1.00 in.	0	0	0	0
				TOTALS:	0	0	10K	0

Note: See bullets following Table 6.3.5-1 for column heading definitions.

Based on historical records from the NCDC database, the future probability of hail events in Middlesex County is reasonably high. On average, a hail event occurs every 2.5 years based on past records. However, property damage and impact to life in Middlesex County is considered minimal compared to the potential damage from other hazards.

6.3.9 Hazardous Materials Release – Fixed Site

Description of the Hazardous Material Release-Fixed Site Hazard

Hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants. Hazardous materials in various forms can cause death, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines. This section deals those hazardous materials that occur at facilities which are known as fixed site. The next section, 6.3.10 deals with hazardous materials as they relate to transportation routes (off-site). See Appendix D for a more detailed description of the hazardous materials – fixed site hazard.

Location of the Hazardous Material Release-Fixed Site Hazard

Middlesex County is made up of densely populated residential, commercial and heavy industrial land uses and facilities. Consequently, the Middlesex County Hazardous Materials Unit indicates there are over 3,500 facilities that use, produce, or store hazardous materials in the county. This represents 30% of all facilities in the State of New Jersey[20]. These facilities also produce the widest variety of chemicals in the state. Although the scale is usually small, emergencies involving the release of these substances can occur daily at both these fixed sites and on the county's streets and roadways.

There are several sources of information regarding the locations of hazardous materials. There does not appear to be a single comprehensive source that identifies all hazardous materials. There are several open sources of information about hazardous materials. These include the Discharge Prevention Office of Middlesex County, the US Environmental Protection Agency (EPA), the FEMA HAZUS (Hazards US) software, the Right-to-Know (RTK) Network (which also acts as a switchboard for access to several other related databases), and local officials responsible for administering the Right to Know Hazardous Substance List (RTKHSL) under the New Jersey Worker and Community Right to Know Act. The paragraphs below describe sources of information about hazardous materials in New Jersey. .

Discharge Prevention Office for Middlesex County

The Discharge Prevention Office for Middlesex County maintains required records on the following sites:

Fixed Facilities

- 144 Superfund Amendments and Reauthorization Act (SARA) Facilities
- 18 Toxic Catastrophe Prevention Act (TCPA) Facilities
- 79 Discharge Prevention, Containment and Countermeasure (DPCC) / Spill Prevention, Control and Countermeasure (SPCC) Facilities
- 9 Treatment Storage Disposal (TSD) Facilities
- 78 Licensed for Radioactive Material
- 17 Oil Pollution Act (OPA 90) Facilities

[20] Middlesex County website: Public Health Department -Hazardous Materials Unit

- 727 Known Contaminated Sites (KCS)
- 2,426 Community Right to Know Facilities
- 78 Biological Laboratories

At the Middlesex County level, there are over 1,200 reportable discharges of hazardous substances each year (discharges are a combination of fixed sites and transportation), of which approximately 750 require response actions. Because the risk of hazardous materials incidents is constant, the County of Middlesex has important programs in place[21] .

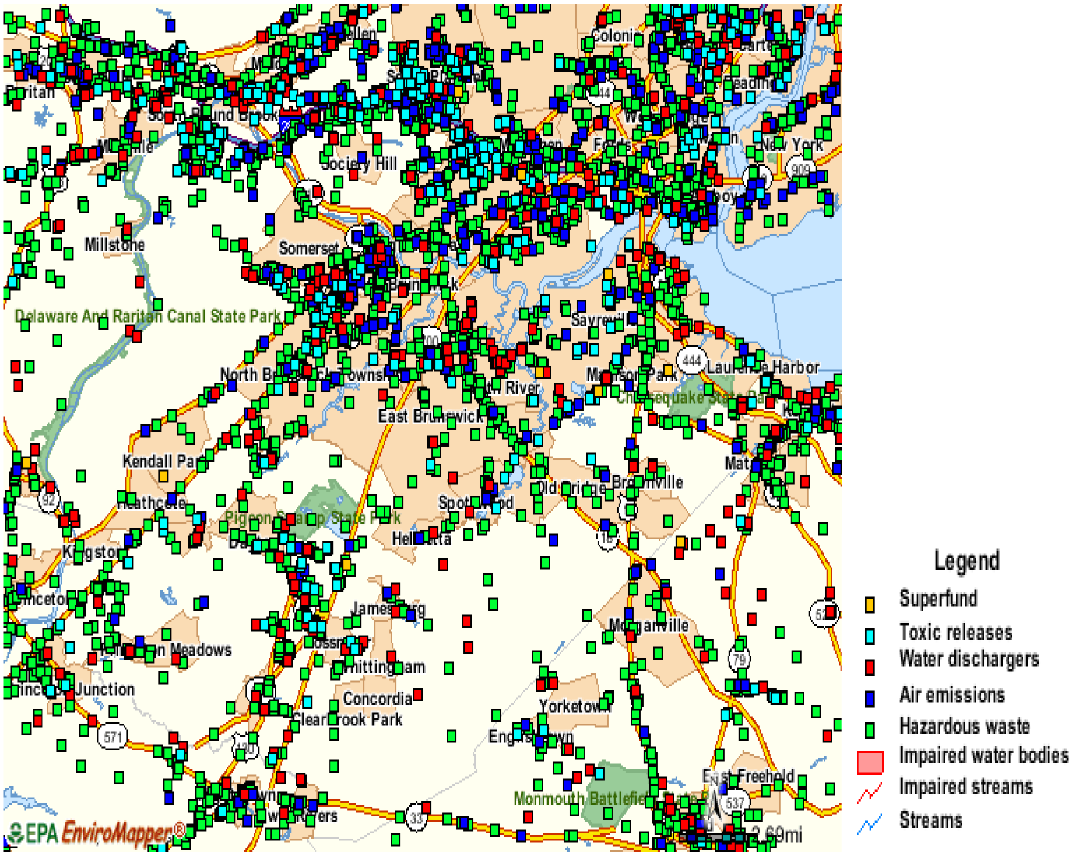
- P. L. 1991, Chapter 99 declares that it is the policy of the State of New Jersey to provide for the administration of environmental health services by county departments of health consistent with performance standards promulgated by the New Jersey Department of Environmental Protection (NJDEP) at N.J.A.C. 7:1H-1.1. The environmental health services include monitoring and enforcement of environmental health standards to control air pollution, solid waste, hazardous waste, noise, radiation, and water pollution to protect workers and the public from hazardous substances and toxic catastrophes, and to protect against other environmental threats. The Middlesex County Public Health Department's Environmental Division provides, or makes available, air pollution, solid waste, recycling, noise pollution, water pollution, septic management, GIS and radon education services on a county-wide basis.
- The primary agency for hazardous materials response in the County of Middlesex is the Middlesex County Hazardous Materials Unit. The Hazmat Unit, started in 1979 by six municipalities, is one of New Jersey's first regional emergency services. The Unit was absorbed into the county government in 1981 which has allowed all twenty-five municipalities to have specialty response capabilities without having to duplicate expensive equipment and extensive training required to provide competent service. The Unit is comprised of full-time career employees who are on call twenty-four (24) hours a day, seven days a week. The Unit is an active participant in the New Jersey County Environmental Health Act (CEHA) having signed agreements with the New Jersey Department of Environmental Protection for Hazardous Substance Emergency Response.
-

US Environmental Protection Agency (EPA)

The EPA is host to a variety of databases related to hazardous materials. In addition to storing hazardous material related data, this information can also be mapped. The EPA has developed a tool referred to as EnviroMapper to map various types of environmental information, including air releases, drinking water, toxic releases, hazardous wastes, water discharge permits, and Superfund sites. The database of maps can be used to select a geographic area within "EnviroMapper" and view the different facilities that are present within that area. Maps can be created at the national, state, and county levels[22]. Figure 6.3.9-1 is a map of Middlesex County displaying various hazardous material categories, including Superfund sites, Toxic Releases, water discharges, air emissions, and hazardous waste.

[21] www.co.middlesex.nj.us
[22] US EPA – Enviromapper

Figure 6.3.9-1
Middlesex County Fixed Hazmat Sites
(Source – US EPA Enviromapper)



Right to Know Hazardous Substance List (RTKHSL)

The 2007 RTKHSL contains 2,455 hazardous substances. The list and associated descriptive information can be found on the State of New Jersey Department of Health and Senior Services website at located at http://web.doh.state.nj.us/rtkhsfs/rtkhsl.aspx.

FEMA HAZUS (Hazards US)

In the spring of 2008 HAZUS version MR1 (v.1.1) was queried to identify hazardous materials for each county in New Jersey. Review of the HAZUS technical manual indicates that the source data for the hazardous materials is from the EPA Toxic Release Inventory (TRI) database queried for the year 1999 (see description under Right-to-Know subsection below and past occurrences of hazardous materials – fixe site). The HAZUS database of hazardous material facilities is limited to facilities where large quantities of chemicals that are considered highly toxic, flammable or highly explosive are stored [23]. The technical documentation recommends that the database be supplemented by local information about hazardous material sites to perform a more detailed vulnerability assessment.

[23] HAZUS – Technical Manual, Chapter 10 – Hazardous Materials Release

Table 6.3.9-1 summarizes the HAZUS results for cities identified as having hazardous material facilities in Middlesex County. Although the HAZUS database includes specific chemical and company names, the results have been summarized to include only the city name, number of facilities, and chemical quantities (in pounds). More detailed information about the results of the HAZUS query can be obtained from the New Jersey Office of Emergency Management. It should be noted that because of the processes involved in updating HAZUS, data included in periodic updates is frequently not as current as what is available on various State databases. HAZUS is used in this case because it offers the only single County-wide database of materials inventories. The RTK network (described below) supports more detailed site-specific data searches, and is the recommended resource for most planning purposes.

Table 6.3.9-1
Middlesex County: HAZUS Hazardous Material Inventory
(Source: HAZUS version MR1 (v.1.1))

City Name	No. of Facilities	Chemical Quantities (Pounds)
Avenel	5	92
Bound Brook	1	16
Carteret	6	129
Clark	1	10
Cranbury	3	6
Dayton	2	32
East Brunswick	2	22
Edison	16	252
Fords	2	28
Jamesburg	1	6
Metuchen	1	0
Middlesex	1	3
Monmouth Junction	2	12
New Brunswick	5	116
North Brunswick	5	85
Old Bridge	2	46
Parlin	2	78
Perth Amboy	5	124
Piscataway	8	120
Plainsboro	2	6
Port Reading	2	127
Sayreville	1	25
Sewaren	2	63
South Plainfield	11	106
Spotswood	1	7
Woodbridge	4	60
Total	**93**	**1571**

The Right-to-Know Network (RTK)

The Right-to-Know (RTK) network contains data related to hazardous materials that has been compiled from various EPA databases. Several databases from the RTK site include the following

- **Toxic Release Inventory (TRI).** Releases and transfers of toxic chemicals from large facilities. See Occurrences of Hazardous Materials Release – Fixed Site for additional details about the TRI database and releases for Middlesex County.
- **Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS).** Information on potential and actual Superfund Sites.
- **Emergency Response Notification System.** Toxic Chemicals and spills reported to the National Response Center. See past Occurrences of Hazardous Materials Release – Transportation for additional details about this database and a list of past transportation accidents in Middlesex County.
- **Facility Registry System.** Names, addresses, and ID numbers of all facilities regulated by the EPA.
- **Biennial Reporting System (BRS).** The BRS is one of EPA's primary tools for tracking the generation, shipment, and receipt of hazardous waste. The BRS appears to be the best U.S. hazardous waste tracking database. It contains information from the Hazardous Waste Reports that must be filed every two years under the RCRA program. RCRA (the Resource Conservation and Recovery Act) is the federal statute that regulates the generation, treatment, storage, disposal, or recycling of solid and hazardous waste. Facilities must report their activities involving hazardous waste to BRS if they fulfill one of two criteria: they are a Large Quantity Generator (LQG) of waste, or they treated, stored, or disposed of RCRA hazardous waste on site in units subject to RCRA permitting requirements. An LQG is defined as any site that generates more than 2,200 lbs of RCRA waste in a single month, accumulates more than 2.2 pounds of RCRA acute hazardous waste in any single month, or accumulates more than 220 lbs of spill cleanup material contaminated with RCRA acute hazardous waste in any month. The RTK site includes BRS records from 1989 through 2005.

Each of the databases listed can be queried from the following website: http://www.rtknet.org/.

Table 6.3.9-2 provides a summary of the waste generated in Middlesex County for the years 2001, 2003, and 2005 from the BRS. The table identifies Federal tons managed and generated for each of these reporting years. The database identifies the total and Federal waste generated. Federal waste includes only those wastes that have a Federal EPA waste code -- those that do not are wastes regulated by an individual state only.

Table 6.3.9-2:
Hazardous Waste – Tons Generated and Tons Managed by Municipality: Middlesex County, 2001 – 2005
(Source: The Right-to-know Network (RTKnet.org) – Biennial Reporting System)

City Name	2001 # of Facilities	2001 Federal Tons Generated	2001 Federal Tons Managed	2003 # of Facilities	2003 Federal Tons Generated	2003 Federal Tons Managed	2005 # of Facilities	2005 Federal Tons Generated	2005 Federal Tons Managed
Avenel	0	357.94	357.94	8	316.78	325.35	7	464.93	465.98
Carteret	12	1,206.52	1,207.35	9	1,912.88	696.82	10	872.02	776.40
Cranbury	6	160.09	649.21	5	63.38	63.38	6	108.42	129.09
Dayton East	7	683.38	683.13	5	461.27	492.16	6	730.95	730.95
Brunswick	3	351.29	351.29	1	107.00	107.00	0	0.00	0.00
Edison	29	6,494.14	4,814.42	21	2,848.59	2,848.60	16	3,653.77	3,635.80
Fords	2	59.61	59.61	1	26.30	26.30	1	18.87	18.87
Iselin	1	25.02	25.02	1	16.80	16.80	1	21.11	21.11
Jamesburg	2	13.88	13.88	1	18.10	18.10	1	76.57	76.57
Keasbey	2	31.95	31.95	0	0.00	0.00	1	12.45	12.45
Metuchen	3	114.92	114.92	1	1.54	1.54	1	5.12	5.12
Middlesex	4	43,383.71	83,639.47	4	22,203.48	71,828.44	7	43,713.73	92,881.89
New Brunswick	9	2,322.04	2,322.05	6	7,538.07	7,538.08	11	11,543.31	11,543.31
Monmouth Junction	6	282.37	213.72	5	305.26	305.26	5	487.07	487.07
Monroe Township	1	54.86	54.86	0	0.00	0.00	0	0.00	0.00
North Brunswick	8	1,452.20	1,461.49	5	156.41	156.41	5	52.13	60.91
Old Bridge	2	8,283.82	8,284.62	1	3,778.07	3,778.07	1	1,498.41	1,498.41
Parlin Perth	6	7,658.34	7,654.40	2	118.28	118.26	5	600.16	600.16
Amboy	7	17,852.76	12,793.23	7	23,860.60	23,860.60	13	17,704.26	10,536.33
Piscataway	12	1,092.56	1,093.52	9	460.69	459.44	14	412.27	414.20
Plainfield	1	3.88	3.88	0	0.00	0.00	0	0.00	0.00
Plainsboro	3	703.48	701.35	2	231.12	239.72	5	195.31	195.18
Port Reading	1	966.77	966.77	1	1,216.04	1,216.04	1	341.37	340.77
Princeton	2	4.29	4.29	0	0.00	0.00	0	0.00	0.00

City Name	# of Facilities	2001 Federal Tons Generated	Federal Tons Managed	# of Facilities	2003 Federal Tons Generated	Federal Tons Managed	# of Facilities	2005 Federal Tons Generated	Federal Tons Managed
Sayreville	3	10,430.62	10,430.62	1	10,496.43	10,496.43	5	19,025.46	19,014.00
Sewaren	4	78.92	78.92	1	6.78	6.78	2	10.54	4.54
Somerset	0	0.00	0.00	0	0.00	0.00	1	88.14	88.14
South Amboy	0	0.00	0.00	0	0.00	0.00	1	0.70	0.70
South Plainfield	8	1,279.18	1,354.00	7	965.52	984.28	8	844.57	809.38
Spotswood	0	0.00	0.00	1	3.90	3.90	1	15.20	15.20
Woodbridge	13	16,831.55	16,828.08	3	113.63	113.63	1	93.46	93.46
Total	**157**	**122,180.06**	**156,193.95**	**108**	**77,226.90**	**125,701.38**	**136.00**	**102,590.28**	**144,455.94**

Severity of the Hazardous Material Release - Fixed Site Hazard

The severity of a hazardous material release relates primarily to its impact on human safety and welfare and on the threat to the environment.

Threat to Human Safety and Welfare

- Poisoning of water or food sources and/or supply
- Presence of toxic fumes or explosive conditions
- Damage to personal property
- Need for the evacuation of people
- Interference with public or commercial transportation

Threat to the environment

- Injury or loss of animals or plants or habitats that are of economic or ecological importance such as; commercial, recreation or subsistence fisheries (marine plants, crustaceans, shellfish, aquaculture facilities) or livestock; seal haul outs; and marine bird rookeries
- Impact to recreational areas such as public beaches
- Impact to ecological reserves, forests, parks, archaeological and cultural sites

Incident severity is often ranked from 1 to 3 or 4, with a “Level 1” incident considered minor; a Level 2, moderate; a “Level 3,” major; and a “Level 4” severe. Thresholds depend on the sort of incident and hazards. The following table is for releases of hazardous material (using a 1- 4 scale):

Table 6.3.9-3:
Hazardous Materials
Incident Severity by Category

Category	Severity of Incident	Extent of Incident	Type of Material Involved	Amount of Material Involved	Population Affected	Resources/ Notification
Category 1 (Minor)	A spill, release or potential release of a known hazardous substance.	Limited to initial area of involvement and unlikely that it will spread. For example, a single structure or area of 300 feet or less	Identified hazardous substance that is not radioactive, water reactive or hypergolic. Generally a flammable or combustible liquid but could also include limited amounts of corrosiveness.	A limited amount of a hazardous substance or smaller container. Generally less than 55 gallons.	Evacuation will be limited to the immediate area that can be evacuated in a short period of time for a limited duration (usually does not exceed 4 hours). A limited number of the populace will be affected.	Local resources can handle, includes automatic mutual aid agreements.
Category 2 (Moderate)	A spill, release or potential release of known or unknown hazardous substance. No deaths; injuries can be minor to severe	Release may not be controllable without special resources. Limited to several blocks or buildings.	Unknown hazardous substance or hazardous substance that is toxic, reactive, flammable, radioactive, corrosive, or biological in nature.	An amount limited by the size of the container and the release from it. For example, a small leak from a tanker that is controlled would be a Level II, while a complete failure releasing the entire contents would be a Level III or IV.	Evacuation will be considered to a designated area that local resources can achieve. Extended sheltering is not required.	Local response agencies may need assistance from outside sources. Note 1.
Category 3 (Severe)	A spill, release or potential release of a hazardous substance with an associated fire, explosion or toxic/corrosive cloud. Injuries or deaths may have already occurred.	Large area may be impacted possibly disrupting essential community services. Extensive environmental contamination is possible.	Unknown hazardous substance or hazardous substance that is capable of producing a toxic/corrosive gas cloud, is highly reactive or unstable, is a flammable gas or produces significant flammable vapors, is radioactive or chemical/biological pathogen.	Large amounts of hazardous material or limited amount of a very dangerous substance.	Presents an immediate danger to the public and operating personnel. Evacuation will require large numbers of the populace and/or extending over an area that will have a significant impact on the community. It may require activation of shelters for evacuees.	Local response agencies will need assistance from outside sources. Note 1.

Category	Severity of Incident	Extent of Incident	Type of Material Involved	Amount of Material Involved	Population Affected	Resources/ Notification
Category 4 (Major)	A spill or release of a hazardous substance that has resulted in a serious fire, explosion or environmental contamination over an extended area.	Has an impact over a wide area with the probability that it will spread to a larger area. The impacted area can be smaller in a highly urbanized area with a large population impacted.	A known or unknown hazardous substance that can be highly toxic, very reactive or unstable, flammable or explosive; etiological agents that are extremely pathogenic.	A hazardous substance in a large amount that can affect a large	Evacuation will affect a large area and will have to be done in stages taking several hours or more (evacuation duration could exceed several days). A large number of the populace is affected. Presents immediate danger to the public and operating personnel.	Mutual aid will be needed with a need for a large number of resources. Note 1.

In Middlesex County the severity of hazardous material releases can be ranked by several methods. The EPA Toxic Release Inventory (TRI) database within the RTK Network described above ranks the top cities for on-site releases, the top chemicals released, and the top companies for releases.

The following two tables (Tables 6.3.9-4 and 6.3.9-5) display the top five on-site releases and the top five chemicals released in Middlesex County between 1987 and 2006. The results from the TRI database show that the Township of Edison released just over 18 million pounds during this time period, followed by the Township of North Brunswick just under 15 million pounds. The top chemical released during this same time period was Toluene. Toluene is a colorless flammable liquid, which is obtained from coal, tar or petroleum and used in aviation fuel and other high-octane fuels, explosives, and as a solvent for gums and lacquers.

Table 6.3.9-4:
Middlesex County: Top 5 Cities for On-Site Releases, 1987 - 2006
(Source: Right-to-Know Network – Toxic Release Inventory)

City Name	Quantity Releases (Pounds)
Township of Edison	18,180,680
Township of North Brunswick	14,937,746
Township of Woodbridge	12,499,570
Township of Piscataway	6,068,726
Parlin	5,244,276

Table 6.3.9-5:
Middlesex County: Top Chemicals for On-Site Releases, 1987 - 2006
(Source: Right-to-Know Network – Toxic Release Inventory)

Chemical Name	Quantity Releases (Pounds)
Toluene	21,466,854
Zinc compounds	16,414,135
Sulfuric acid	9,545,774
Xylene (mixed isomers)	8,709,167
Glycol ethers	8,389,307

Impact on Life and Property

Hazardous materials incidents (fixed sites) refer to uncontrollable releases of hazardous materials at a facility, which poses a risk to the health, safety, property, and the environment (MSP/EMD). The most well-known example of a large-scale fixed-site hazardous materials incident is that which occurred at the Union Carbide plant in Bhopal, India in 1984. This incident caused 2,500 deaths and injuries to many others. Although incidences of this scale are fairly rare, smaller-scale incidents - those requiring a response and evacuation or other protective measures - are relatively common. Table 6.3.9-6 below illustrates the relatively small number of Hazardous Materials related incidents that led to a Presidentially-declared disaster.

Table 6.3.9-6:
Hazmat Related Federal Disaster Declarations
(Source: FEMA)

Disaster Number	Declared	State	Description
3126	06/10/1998	Kansas	Kansas Grain Elevator Explosion
3094	09/16/1992	Rhode Island	Water Contamination
3092	09/04/1987	Wyoming	Methane Gas Seepage
636	03/17/1981	Kentucky	Sewer Explosion, Toxic Waste
3080	05/21/1980	New York	Chemical Waste, Love Canal
3066	08/07/1978	New York	Chemical Waste, Love Canal
139	11/05/1962	Louisiana	Chlorine Barge Accident
135	10/10/1962	Mississippi	Chlorine Barge Accident

The Office of Hazardous Materials Safety (DOT) tracks hazardous materials incidents by state. New Jersey has had 65 major incidents since 2001, with 10 injuries reported and a damages totaling $5,739,540, an average of $819,934 per year. Based on the intensity of mixed land use in Middlesex County (including heavy industrial and commercial uses), the likelihood for continued Hazardous Material incidents to occur is high within the planning area. Section 7 of this plan includes a more detailed discussion related to the impacts of hazardous materials within Middlesex County.

Occurrences of the Hazardous Material Release-Fixed Site Hazard

To identify past occurrences for fixed sites in Middlesex County the Toxic Release Inventory (TRI) Explorer database was queried from the US Environmental Protection Agency's (EPA) website. Beginning in 1986, as part of the Emergency Planning and Community Right-to-know Act (EPCRA), certain industries as well as federal facilities have been required to report the locations and quantities of chemicals stored on-site to state and local governments in order to help communities prepare to respond to chemical spills and similar emergencies. EPCRA Section 313 requires the EPA and the States to annually collect data on releases and transfers of certain toxic chemicals from industrial facilities, and make the data available to the public as part of the Toxics Release Inventory (TRI)[24]. In 1990 Congress passed the Pollution Prevention Act which required that additional data on waste management and source reduction activities be reported under the TRI program.

For Middlesex County, the TRI database was queried for the years 2000 through 2006, the most recent year available. For years 2000 – 2006, the results of the query are summarized below in Table 6.3.9-7. The total onsite and off-site disposal or releases is reported in pounds, and includes facilities for all types of industries and chemicals in Middlesex County. The table results show the number of facilities reported in the TRI database for Middlesex County has decreased from a high of 108 in 2001 to 72 in 2006. The quantity of the combined on and off-site disposal and releases has decreased from a high of 9,301,512 pounds in 2001 to 559,172 pounds in 2006.

[24] EPA – TRI Program

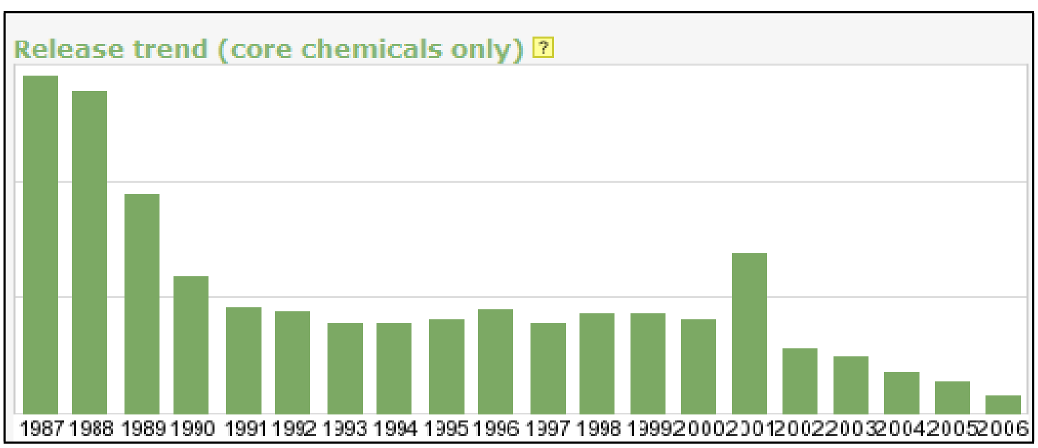
Table 6.3.9-7:
Middlesex County Toxic Release Inventory: 2000 – 2006
Summary of On-site and Off-site Reported Disposed of or Otherwise Released (in pounds)
(Source: US EPA – Toxic Release Inventory Database)

Year	# of Facilities Reported (TRI Explorer)	Total On-site Disposal or Other Releases (Pounds)	Total Off-site Disposal or Other Releases (Pounds)	Total On- and Off-site Disposal or Other Releases (Pounds)
2000	104	2,060,178	2,831,951	4,892,129
2001	108	1,785,838	7,515,674	9,301,512
2002	98	1,280,591	2,114,410	3,395,001
2003	92	1,221,440	1,611,420	2,832,860
2004	90	969,262	1,185,054	2,154,316
2005	79	807,284	903,328	1,710,612
2006	72	66,183	492,989	559,172
Total		**8,190,776**	**16,654,826**	**24,845,602**

The details of the query for year 2006 are included in Appendix E. The table includes the facility address, type of chemical disposed or released, and the quantity of on and off-site releases. The Middlesex County results for 2006 have been included as sample, the details for years 1988 - 2006 can be found by querying the TRI Explorer database within the EPA's website. To query the database, navigate to the EPA -TRI home page located at http://www.epa.gov/tri and select "Get TRI Data" from the menu on the left side of the page. Then select the link "TRI Explorer", and "Facility" from the reports menu.

The reduction in releases for Middlesex County can also be show graphically by displaying the TRI trend for a list of core chemicals during the period 1987 to 2006. For standard comparison purposes, the core chemical list excludes chemicals that have been added or removed within the reporting period. The core chemical restriction is applied to all RTK bar charts that display yearly trends. Figure 6.3.9-2 illustrates that over the past 20 years the pounds released in Middlesex County has dramatically been reduced from the peak in 1989 and 1990. With the exception of 1994, the trend downward has continued in the 1990's and years 2000 - 2006.

Figure 6.3.9-2
Middlesex County Toxic Release Inventory Trend (Core Chemicals): 1987 – 2006
(Source: Right-to-Know Network – Toxic Release Inventory)



6.3.10 Hazardous Materials Release - Transportation

Description of the Hazardous Material Release- Transportation Hazard

As described in section 6.3.9, hazardous materials come in the form of explosives, flammable and combustible substances, poisons, and radioactive materials. These substances are most often released as a result of transportation accidents or because of chemical accidents in plants. Hazardous materials in various forms can cause death, serious injury, long-lasting health effects, and damage to buildings, homes, and other property. Many products containing hazardous chemicals are used and stored in homes routinely. These products are also shipped daily on the nation's highways, railroads, waterways, and pipelines. This section deals those hazardous materials as they relate to transportation routes (off-site).

Hazardous materials release-transportation incidents refer to uncontrollable releases of hazardous materials during transport, which pose a risk to the health, safety, property, and the environment. Small-scale incidents – those that require a response and implementation of evacuation procedures or other protective actions - are somewhat common along major U.S. highways, but can also occur through other modes of transportation including rail, water transport (shipping and ferries), air, and pipelines. Data collected by the US Department of Transportation (DOT) shows that transportation related hazardous materials incidents are much more likely to occur on highways than through any other mode of transport. See Appendix D for a more detailed description of the hazardous materials – fixed site hazard.

Location of the Hazardous Material Release-Transportation Hazard

Middlesex County is host to over 3,500 facilities that use, produce, or store hazardous materials. Chemicals are transported along the counties 492 highway miles, 141 railway miles, 155 transmission pipeline miles and 12 petrochemical docks along the Arthur Kill and Raritan Rivers. This is 30% of all facilities in the State of New Jersey. These facilities also produce the widest variety of chemicals in the State.

The Discharge Prevention Office of Middlesex County maintains required records on the following transportation sites:

- 5 Rail yards and Commodity Movements
- 12 Transmission Pipeline Companies
- 12 Marine Petrochemical Docks

In order to manage the data more efficiently the Unit has implemented two computer database programs, CAMEO (Computer Aided Management of Emergency Operations) and OREIS (Operation Respond Emergency Information System).

Middlesex County is uniquely located in a region that is of critical importance to freight transport in the United Sates. Specifically, in relation to the transport of hazardous materials, the region's high potential for hazardous materials release is due to several key factors:

- It collectively houses the major port facilities of Newark international Airport and the marine ports of Newark and Perth Amboy. As such, millions of tons of import/export freight move through the region each year.
- The corridor is an important component of the shortest land path from the Northeastern US to all South-Atlantic States. Thus, an enormous amount of non-local freight traffic is drawn through the area en route to other domestic destinations.
- The region has good accessibility to the metropolitan areas of New York City, Philadelphia, and Pittsburgh, and therefore is a good staging location for warehousing and distribution activity. Moreover, 40% of the US population is accessible within a single day's drive from New Jersey.
- In addition to air and water ports, the region has good rail access and contains several rail intermodal facilities. Moreover, seven major highways merge in the area: Interstates 78, 80, 95, 280, and 287, plus the New Jersey Turnpike (NJTP) and Garden State Parkway (GSP). This region thus serves as one of the most concentrated intermodal "intersections" in the country.
- As a result of the first four points, a large number of warehouse and distribution facilities have clustered in the region (as a state, New Jersey trails only Los Angeles and Chicago in its amount of warehouse square footage).

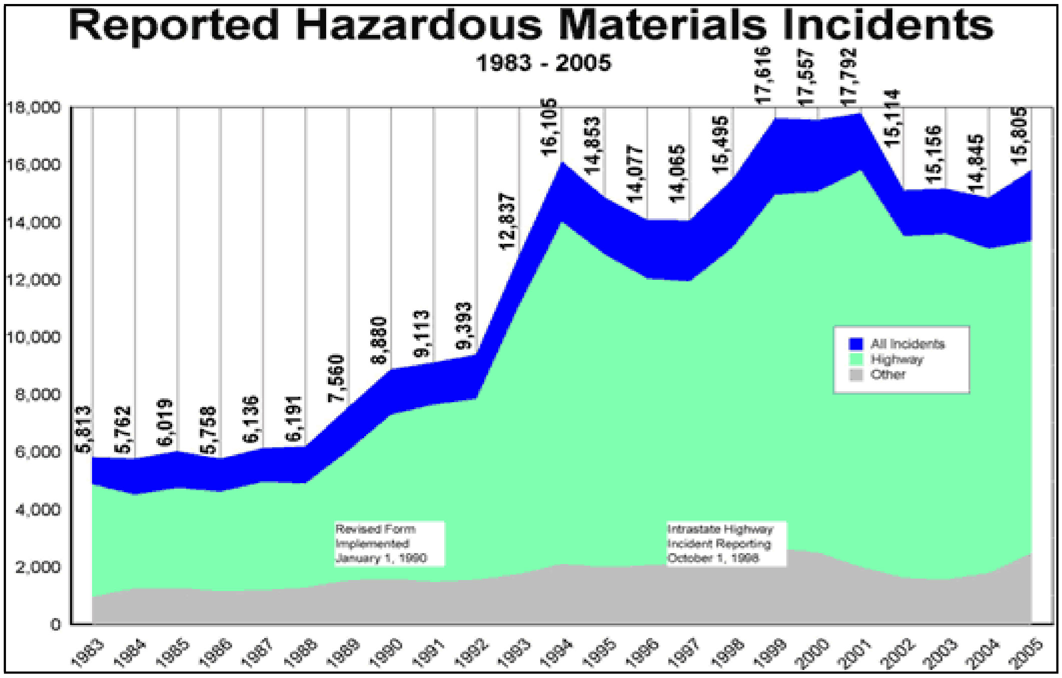
Severity of the Hazardous Material Release-Transportation Hazard

Section 6.3.9 includes a discussion on the severity of hazardous material releases that focuses on an incident severity scale that is ranked from 1 to 3 or 4, with a "Level 1" incident considered minor; a Level 2, moderate; a "Level 3," major; and a "Level 4" severe. Thresholds depend on the sort of incident and hazards.

Impact on Life and Property

Table 6.3.10-1 shows the reported hazardous materials incidents nationwide between 1983 and 2005. Within the graphic, the transportation related incidents are shaded green. This data shows that the vast majority of hazardous materials incidents relate to highway born transport. The data also visually demonstrates that the number of hazardous materials incidents have been steadily increasing since the 1980s as the interstate commerce has increased. As Central New Jersey, and Middlesex County, continues to grow and maintain its importance as part of a transportation corridor, the likelihood for transportation related hazardous materials releases will continue to grow.

Table 6.3.10-1:
Reported Hazardous Materials Incidents (1983-2005)
(Source: Office of Hazardous Materials Safety)



Occurrences of the Hazardous Material Release- Transportation Hazard

To identify past hazardous material transportation incidents for Middlesex County the Emergency Response Notification System (ERNS) database was queried from the Right-to-Know website. The ERNS database is a database of incidents reported to the National Response Center. The National Response Center is operated by the US Coast Guard, and has become the central point of contact used for the reporting of many different kinds of incidents involving hazardous materials[25]. The database includes 12 incident types including vessels (ships), railroads, pipelines, and surface transportation.

Table 6.3.10-2 summarizes past hazardous materials transportation incidents for Middlesex County between 1990 and 2002. The table lists 27 prior incidents and with the exception of one vessel accident are all related to road traffic accidents. There are most likely additional incidents (and incident types) that are not reported in the database. However, this was the best available data at the time the plan was developed. Future plan updates will review the available data sources and integrate any additional incidents that may be identified.

[25] Right-to-know Network – ERNS database

Table 6.3.10-2:
Middlesex County Transportation Incidents: 1990 - 2002
(Source: The Right-to-know Network (RTKnet.org))

Incident Date	City Near Location	Incident Description	Incident Location	Amount Of Material Released	Name of Material	Remedial Action
September 17, 1990	Edison Township	Transformer was knocked down by an auto	Thornall RD off Evergreen Ave	36 gallons	Oil, Misc: Transformer	Material contained in a storm basin and vacuum truck used to recover material
December 14, 1990	New Brunswick	Reporting a tractor trailer accident, cause is unknown	RT 1 South, just before Ryders Lane Exit	Unknown	Gasoline: Automotive (4.23PB/G	Local fire dept responded
June 23, 1991	Carteret	Tank truck/accident	Roosevelt Ave and NJ Turnpike	800 gallons	Gasoline: Automotive (4.23PB/G	Local fire dept responded - Clean Venture contractor responded
May 23, 1991	Middlesex	55 Gallon drum/leaking	Reagent Chemical Plant 5 Factory Lane	2 gallons	Arsenic Liquid Waste	Material was contained and cleaned up
July 15, 1991	New Brunswick	Truck fuel leak/hit orange cone on road	Joyce Kilmer Service Station on the Jersey Turnpike	100 gallons	Oil: Diesel	DOT put out sand. Company hired Clean Ventures cleanup services
May 29, 1991	Plainsboro	Dump truck/accident	Dey Rod & Scot's Corner	10 gallons	Hydraulic Oil	Fire Department Responded
June 23, 1991	Woodbridge	Overturned tractor trailer	Approach Ramp to Exit 12 on NJ Turnpike	Unknown	Gasoline: Automotive (4.23PB/G	Clean Venture and Angus performing cleanup
January 13, 1992	Sewaren	Storage tank/punctured by a forklift	Arbor St	50 gallons	Cobalt Sulfate (OUS)	Neutralized material and recovered with sorbents/excavated contaminated soil
March 11, 1993	Edison	Fuel tank on tractor trailer/leaked when truck struck guardrail	Southbound Jersey TNPK between Interchange 9-10	30 gallons	Oil, Fuel: No. 2-D	Contractor cleaned up
February 18, 1993	Edison	UPS vehicle/metal grating on drain ruptured truck's tank when the truck went over the drain	1 Clover Place	50 gallons	Oil: Diesel	Contractor on scene conducting cleanup
January 5, 1993	Elizabeth	Tractor trailer fuel tank/punctured in tank due to running over Debris in yard	Yellow Freight System 100 3rd Ave	300 gallons	Oil, Fuel: No. 2-D	Contractor en route
June 21, 1994	Avenale	Driver caught corner of fuel tank on low spot on road	Pivot Systems Terminal Way BLDG 2A	100 gallons	Oil: Diesel	DEP and Fire Dept on scene/contractor en route
May 4, 1994	Bound Brook	30 gallon drum/drum spilled while being transported in a truck	515 E Main St	15 gallons	Mineral Spirits	Sorbents used

Incident Date	City Near Location	Incident Description	Incident Location	Amount Of Material Released	Name of Material	Remedial Action
August 5, 1994	Edison	Hazmat truck/overturned resulting in a road closure/no release of product/truck was carrying compressed air	Plainfield Ave at Woodbridge Ave Crossing	Unknown	Unknown	Police and Fire Dept responded and road was re-opened
June 21, 1994	New Brunswick	55 gallon drum/fell over during transport resulting in puncture	755 Jersey Ave	55 gallons	Crotonaldehyde	Unknown
November 20, 1995	North Brunswick	Saddle tank of truck hit curb	Jersey Ave	75 gallons	Oil: Diesel	Sand on street. Sorbent Pads used for storm drain and creeks as well as booms deployed.
August 26, 1995	Old Bridge	Tank truck was in an accident. Truck was struck by another vehicle/valve leak detected	Route 9 and Ernston RD	5 gallons	Gasoline: Automotive (4.23G PB/G	Mobil hazmat team responded
May 4, 1997	East Brunswick	Pole mounted transformer/auto accident	RT 18 & Cranbury Road	9 gallons	Oil, Misc: Transformer (Non-PCB)	Hazmat response team responded as part of cleanup
September 16, 1998	Old Bridge	Driver exiting State Hwy 9 South Bound onto State Hwy 34 when trailer rolled over on right side	State Hwy 9 Ramp to State Hwy 34	Unknown	Unknown	Southbound ramp portion of Hwy 34 was closed for a short time period.
December 23, 1999	East Brunswick	55GAL drum leaked inside tractor trailer	61 Edgeboro Road	Unknown	Compound, tree or weed killing, liquid	Local fire dept responded
November 1, 1999	Edison	Semi truck was involved in a single vehicle accident	Intersection of 1-287 and RT 1	24 tons	Contaminated soil (PCB < 50PPM)	The release was secured/contaminated soil was placed back into the trailer
August 23, 1999	Metuchen	A truck carrying Hazmat's struck another non-hazmat carrying truck due to brake failure/the cargo shifted causing a spill of cleaning fluids	RTE 287 North at intersection of RTE 1	5 gallons	Bleach Product	The county hazmat team responded. The leaking containers were removed and the roadway was cleaned
January 13, 1999	South Plainfield	Tanker truck was hit by another vehicle	Thelma Ave	Unknown	Propane	Emergency shut off valve was shut and the release was secured
December 12, 2000	Carteret	The caller stated that a gasoline tanker truck rolled over onto its side.	Roosevelt Ave/Off of Exit 12 on the New Jersey Turnpike	500 gallons	Gasoline: Automotive	Fire department and contractor responded
May 22, 2001	Linden	Loaded barge collided with pier	Citgo Dock - Arthur Kill	Unknown	Reformate (gas blend stock)	Unknown
July 20, 2003	E. Brunswick	Material released from a pole mount transformer due to a transport accident. Transformer does not contain any PCB'S.	Route 18, Southbound, South Miltown RD	40 gallons	Oil, Misc: Transformer	Material contained, isolated area, and cleaned up

6.3.11 High Wind – Straight Line Winds

(Includes Hurricane, Nor'easter, Tropical Storm, and other Severe Storm)

Description of the Straight Line Winds Hazard

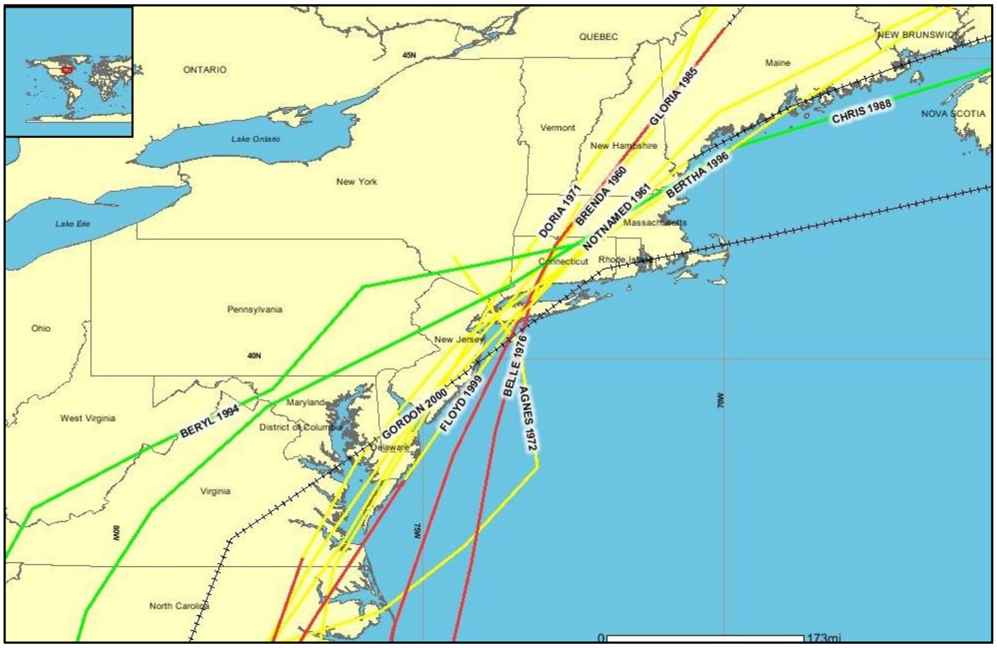
Hurricanes, tropical storms, and typhoons, collectively known as tropical cyclones, are among the most devastating naturally occurring hazards in the United States. They present flooding, storm surge, and high wind hazards to the communities that they impact. A hurricane is defined as a low-pressure area of closed circulation winds that originates over tropical waters. A hurricane begins as a tropical depression with wind speeds below 39 mph. As it intensifies, it may develop into a tropical storm, with further development producing a hurricane.

A nor'easter is an intense low pressure system that typically occurs during the winter months and affects the coastal areas of the Northeast United States and Atlantic Canada. More specifically, it describes a low pressure area, where the center of rotation is just off the coast and whose leading winds in the left forward quadrant rotate onto land from the northeast. The precipitation pattern is similar to other extra-tropical storms. These events can also cause coastal flooding, coastal erosion, and gale force winds. See Appendix D for a more detailed description of hurricanes, nor'easters, tropical storms, other severe events.

Location of the Straight Line Winds Hazard

The entire planning area is subject to the wind effects from hurricanes, nor'easters, tropical storms, other severe events. The hurricane and tropical storm risk in the United States extends along the entire east coast from Maine to Florida, the Gulf Coast (including Florida, Alabama, Louisiana, and Texas), and Hawaii. The northeast US is at a moderate risk based on historical storm tracks and the number of hurricanes that have made landfall along the Atlantic coastline. Figure 6.3.11-1 shows all historical hurricanes that impacted New Jersey and Middlesex County from 1960 to 2007. The map identifies 11 hurricanes or tropical storms and was developed using NOAA's Historic Hurricane Tracks database.

Figure 6.3.11-1
Historic Hurricane Tracks impacting Middlesex County (1960-2006)
(Source: NOAA Coastal Service Center – Historic Hurricane Tracks database)



The high wind risk from nor'easters extends along the entire east coast. Nor'easters typically occur during the winter months and wind speeds can potentially reach hurricane force. In Middlesex, the portion of the county along the Atlantic coastline has the highest risk from nor'easters.

Severity of the Straight Line Winds Hazard

The severity of the wind hazard is measured primarily by velocity, although effects are clearly exacerbated by duration and the presence of debris that can create missiles. As discussed in Section 7, New Jersey is not particularly prone to high wind hazards, but occasionally tropical storms or thunderstorms are severe enough to cause moderate damage in the area. The coastline of northeastern Middlesex County is potentially vulnerable from the high winds associated with hurricanes, nor'easters, and tropical storms, which often follow along the coast as shown by the historic hurricane tracks in Table 6.3.11-1.

Impact on Life and Property

The NCDC database indicates that Middlesex County has experienced 193 thunderstorm and high wind events between 1950 and 2007. During this period there were 11 deaths, 31 injuries and more than $19 million in property damage. The information in the NCDC database, reflect a significant part of the costs of recovery from strong winds. However, there are also very significant costs associated with interrupted business, lost wages, lost tax base, etc. that are very difficult to quantify but are nevertheless important metrics for determining the severity of the risk. Of these 193 events, a total of nine events have exceeded 69 mph since 1960. These nine events are summarized in Table 6-.3.11-1 below.

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 MIDDLESEX	07/03/1960	1900	Tstm Wind	68 kts.	0	0	0	0
2 NJZ007 - 012>015 - 017 - 019>020 - 026	03/06/1997	05:00 AM	High Wind	63 kts.	0	0	0	0
3 Countywide	09/07/1998	01:10 PM	Tstm Wind	60 kts.	0	1	1.9M	0
4 South Plainfield	05/18/2000	07:00 PM	Tstm Wind	65 kts.	0	0	1.0M	0
5 NJZ001 - 007>010 - 012>026	12/12/2000	08:00 AM	High Wind	62 kts.	0	11	875K	0
6 NJZ001 - 008 - 012>013	12/17/2000	04:00 AM	High Wind	61 kts.	0	0	0	0
7 Plainsboro	09/04/2001	04:40 PM	Tstm Wind	65 kts.	0	0	0	0
8 Countywide	09/23/2003	07:32 AM	Tstm Wind	65 kts.	0	0	0	0
9 NJZ008 - 012>013 - 015>023 - 025 - 027	01/18/2006	04:30 AM	High Wind	60 kts.	0	0	5.3M	0
				TOTALS:	0	12	9.005M	0

Table 6.3.11-1: High Wind Events Over 69 mph, Excluding Tornado Winds, Middlesex County, 1950 – 2007

(Source: NOAA/NCDC)

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

To protect life and property from wind events, all counties within the State of New Jersey, including Middlesex County, are required to comply with the design wind loads developed by the International Building Code (IBC) and the International Residential Code (IRC). The building code administered within the incorporated areas of Middlesex County require all new construction to be designed and constructed between 100 and 110 mph wind loads depending on the location within the county[26].

Occurrences of the Straight Line Winds Hazard

Between 1950 and 2007, there have been numerous hurricanes, nor'easters, tropical storms, and severe storms that have impacted all or part of Middlesex County. The NCDC database identifies no hurricanes or tropical storm events in Middlesex County between 1950 and 2007. However, as shown in Figure 6.3.11-1 above, the historic hurricane track from NOAA identifies 11 hurricanes or tropical storms that have impacted central New Jersey. Most of these events were downgraded to a tropical depression or less by the time they reached New Jersey. There have been numerous nor'easters in the past that have impacted the planning area with high winds. Some of the larger nor'easter events occurred in years 1993, 1996, 2006 and 2007.

Several of the hurricane, tropical storm, and nor'easter events are highlighted below.

- **September 27, 1985 – Hurricane Gloria.** After brushing the outer banks of North Carolina the storm moved northward just off the Atlantic coast until making landfall as a Category Two Hurricane near western Long Island, New York. Along the coastline of northern New Jersey sustained winds were approximately 80 mph with gusts over 100 mph. Hurricane Gloria caused one of the largest single power outages at the time, including about 230,000 customers in New Jersey.

[26] Department of Community Affairs - Division of Codes and Standards: Bulletin No. 3-4 – Wind Speed Map

- **March 16, 1993 (Storm of the Century).** One of the most intense nor'easters to ever effect the United States. The "storm of the Century" label was given to the event due to the record low pressure, wind speeds, temperature and snowfall. Fallen trees from high winds left three million customers without electrical power[27]. Wind gusts of over 70 mph were reported at New York City's LaGuardia airport.
- **October 18, 1996.** A five- day nor'easter that lasted from October 18th – 23rd. Record rainfall, flooding, and high winds effected parts of New Jersey from Morris County to Middlesex County to Hunterdon County.
- **February 12, 2006.** A Nor'easter that impacted the New Jersey shoreline with strong onshore winds that caused coastal flooding and beach erosion.

The planning area has been impacted by 11 hurricanes or tropical storms over the last 47 years. However, as mentioned, almost all had been downgraded to tropical storm or tropical depression status by the time they reached New Jersey. In the future, Middlesex County can be considered at moderate risk from experiencing the high wind effects from hurricanes and tropical storms. The risk is also considered moderate from nor'easters. New Jersey experiences one or two storms every year that could potentially be classified as nor'easters, but not all of these are severe enough to cause significant damages or result in disaster declarations. Middlesex County has been impacted by high winds from four nor'easters over the past 15 years. The planning area is affected by a strong nor'easter on average about every four years. Note that Section 7 of this hazard mitigation plan includes a more detailed discussion about wind risk in Middlesex County.

6.3.12 High Wind - Tornado

Description of the Tornado Hazard

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but they also result from hurricanes and other tropical storms) when cool, dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly.

The damage caused by a tornado is a result of the high wind velocity and wind-blown debris. The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction such as residential homes (particularly mobile homes). The *Enhanced Fujita Scale for Tornadoes* was developed to measure tornado strength (i.e., magnitude or intensity) and associated types of damages (Table 6.3.12-1).

Table 6.3.12-1
Enhanced Fujita Scale for Tornadoes

EF-Scale Number	Intensity Phrase	3 Second Gust (MPH)	Type of Damage Done
F0	Gale	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
F1	Moderate	86–110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.

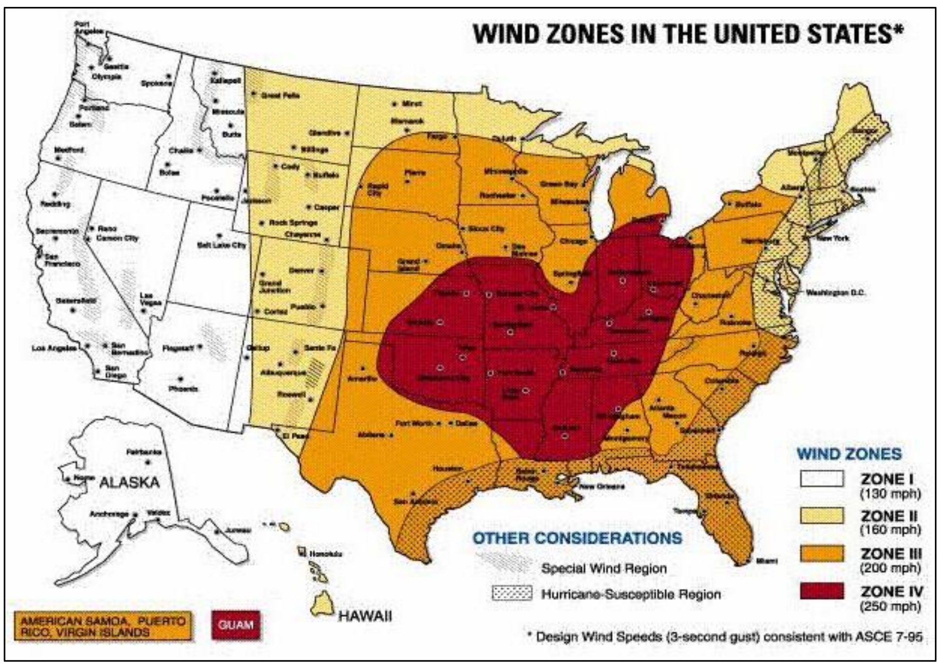
[27] NOAA

F2	Significant	111–135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	Severe	136–165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
F4	Devastating	166–200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	Incredible	Over 200	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.

Hazard Identification

The US Wind Zone Map (Figure 6.3.12-1) shows the areas affected by extreme windstorms. Developed by the US Army Corps of Engineers, it is based on the history of 40 years of tornadoes and 100 years of hurricanes.

Figure 6.3.12-1
US Wind Zone Map
(Source: USACE, 7-95 and FEMA 386-2, p.2-20)



According to this figure, all of New Jersey is within Zone II. The Design Wind Speed for this zone is indicated as 160 miles per hour (mph). Per Table 6.3.12-1, wind speeds of 160 mph are associated with “severe” conditions.

Historical Occurrences

According to NOAA National Climatic Data Center, there have been a total of 7 recorded tornado events in the County between the years of 1950 and 2007. As listed in Table 6.3.12-2, 0 deaths, 8 injuries, and $10,000 in property damages resulted from these events. The magnitude of these tornadoes ranges from F0 to F1 in intensity.

Table 6.3.12-2
Historic Tornado Impacts
(Source: NOAA/NCDC)

Location	Date & Time	Magnitude	Deaths/ Injuries	Property Damage
Middlesex	10/5/1985	F1	0 / 8	$0
Middlesex	7/14/1987	F0	0 / 0	$0
Middlesex	8/29/1989	F0	0 / 1	$0
Middlesex	11/16/1989	F0	0 / 0	$0
Middlesex	7/31/1992	F1	0 / 0	$0
East Brunswick	9/8/1996	F0	0 / 0	$10,000
Highland Park	10/27/2003	F0	0 / 0	$0

Impact on Life and Property

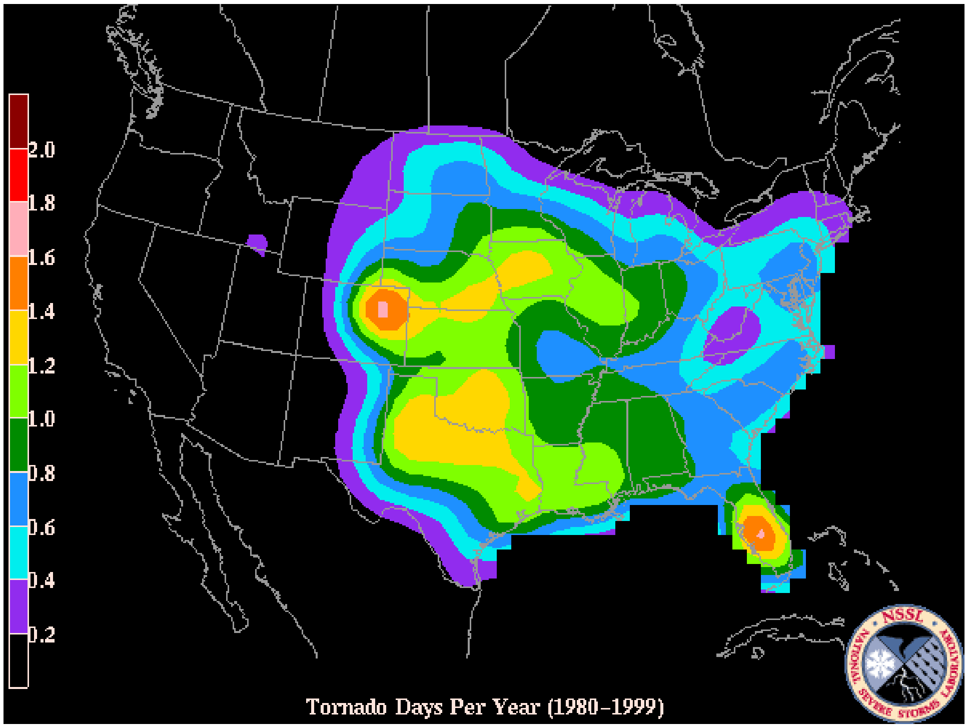
The NCDC database reports there have been no deaths and 8 injuries from tornadoes in Middlesex County. Tornadoes have caused $10,000 in property damage. The most severe tornadoes in the county occurred on September 8, 1996 when one F0 tornadoes caused approximately $10,000 in damages.[28]

Location, Magnitude and Probability

A recent study from NOAA's National Severe Storms Laboratory provided highly accurate and accessible estimates of the long-term threat from tornadoes. Using historical data, the NSSL estimated the daily probability of a tornado occurring near any location in the U.S for any tornado no matter how strong or weak (i.e., no matter what its magnitude). The NSSL map below (Figure 6.3.11-2) can be used to obtain these estimates. For example, the NSSL estimates a probability for any tornado of about 1.3 days per year in south-central Oklahoma, and 0.4 to 0.6 days per year in southern New York.

[28] NOAA/NCDC database

Figure 6.3.12-2
Probability of a Tornado of any Magnitude
(Source: www.nssl.noaa.gov/primer/tornado/tor_hazardgraph.html)



Based on this NOAA NSSL map, the tornado probability for Middlesex County is about 0.6 to 0.8 tornado days per year for any tornado.

6.3.13 Ice Storm

Description of the Ice Storm Hazard

Although snow is the weather phenomenon most commonly associated with winter, ice storms are a much greater winter menace (See Section 6.3.16, Severe Storm – Winter Weather, for a detailed discussion of winter weather). The freezing rain that coats all objects in a sheath of ice can cause power outages, structural damage, damaging tree falls. Ice storms occur when rain droplets fall through freezing air and but do not freeze until they touch objects such as trees, roads, or structures. A clear icy sheath, known as a glaze, forms around branches, structures and wires and has been known to bring down high-tension utility, radio, and television transmission towers. See Appendix D for a more detailed description of the ice storm hazard.

Location of the Ice Storm Hazard

All regions of Middlesex County have been subject to ice storms. Besides temperature, their occurrence depends on the regional distribution of the pressure systems, as well as local weather conditions. The distribution of ice storms often coincides with general distribution of snow. A cold rain may be falling near the coastline in the northeastern part of the county, changing to freezing rain in the central region, and snow over the neighboring interior counties as a coastal storm moves northeastward offshore. A locality's distance to the passing storm center is often the crucial factor in determining the temperature and type of precipitation during a winter storm.

The potential for ice storms is uniform for the entire planning area. All people and assets are considered to have the same degree of exposure.

Severity of the Ice Storm Hazard

The severity of the ice storm hazard is dependent on a variety of factors including the surface temperature, duration of the event, and thickness of the ice.

Impact on Life and Property

The NCDC database indicates there have been no deaths, injuries or property damage from previous ice storms in Middlesex County. However, ice storms clearly have caused both infrastructure and property damage such as downed electrical power lines and trees falling on houses. In addition ice storms potential put lives at risk from automobile accidents on ice covered roadways.

Occurrences of the Ice Storm Hazard

The NCDC database indicates there have been four ice storms that have impacted Middlesex County between 1950 and 2007. In addition to the four ice storms the database indicates there have been 32 wintry mix events that include a combination of snow, sleet, and freezing rain.

A typical event occurred on March 9th and 10th 1994 when a nearly stationary front caused a considerable amount of precipitation to fall as sleet and freezing rain across the interior sections of the county. Transportation and commerce were disrupted as driving on icy roadways became extremely hazardous.

Middlesex County experiences an event that includes freezing rain as part of a winter storm about once every 1.5 years if the past 36 wintry mix events are added to the two ice storms. Based on previous data, the probability of ice storms occurring in the future is relatively high. However the overall impact to life and property throughout the planning area will most likely be low to moderate.

6.3.14 Landslide (non-seismic)

Description of the Landslide Hazard

A landslide is a natural geologic process involving the movement of earth materials down a slope, including rock, earth, debris, or a combination of these, under the influence of gravity. However, there are a variety of triggers for landslides such as: a heavy rainfall event, earthquakes, or human activity. The rate of landslide movement ranges from rapid to very slow. A landslide can involve large or small volumes of material. Material can move in nearly intact blocks or be greatly deformed and rearranged. The slope may be nearly vertical or fairly gentle[29]. See Appendix D for a more detailed description and definition of the Landslide hazard.

[29] Delano and Wilshusen, 2001

Location of the Landslide Hazard

Landslides are usually associated with mountainous areas but can also occur in areas of generally low relief. In low-relief areas, landslides occur due to steepening of slopes: as cut and fill failures (roadway and building excavations), river bluff failures, collapse of mine waste piles, and a wide variety of slope failures associated with quarries and open-pit mines[30] .

In Middlesex County the New Jersey Geological Survey (NJGS) indicates that the most susceptible landslide areas appear to be concentrated in the areas of New Brunswick, Piscataway, and Highland Park as shown in Figure 6.3.14-1 below. The areas shaded orange on the map represent the areas with the highest vulnerability from landslides. There are several other areas within the County that are susceptible to landslides including the southwest border of Cheesequake State Park.

Figure 6.3.14-1
Portion of Middlesex County with the Highest vulnerability to Landslides
(Source: New Jersey Geological Survey)

Severity of the Landslide Hazard

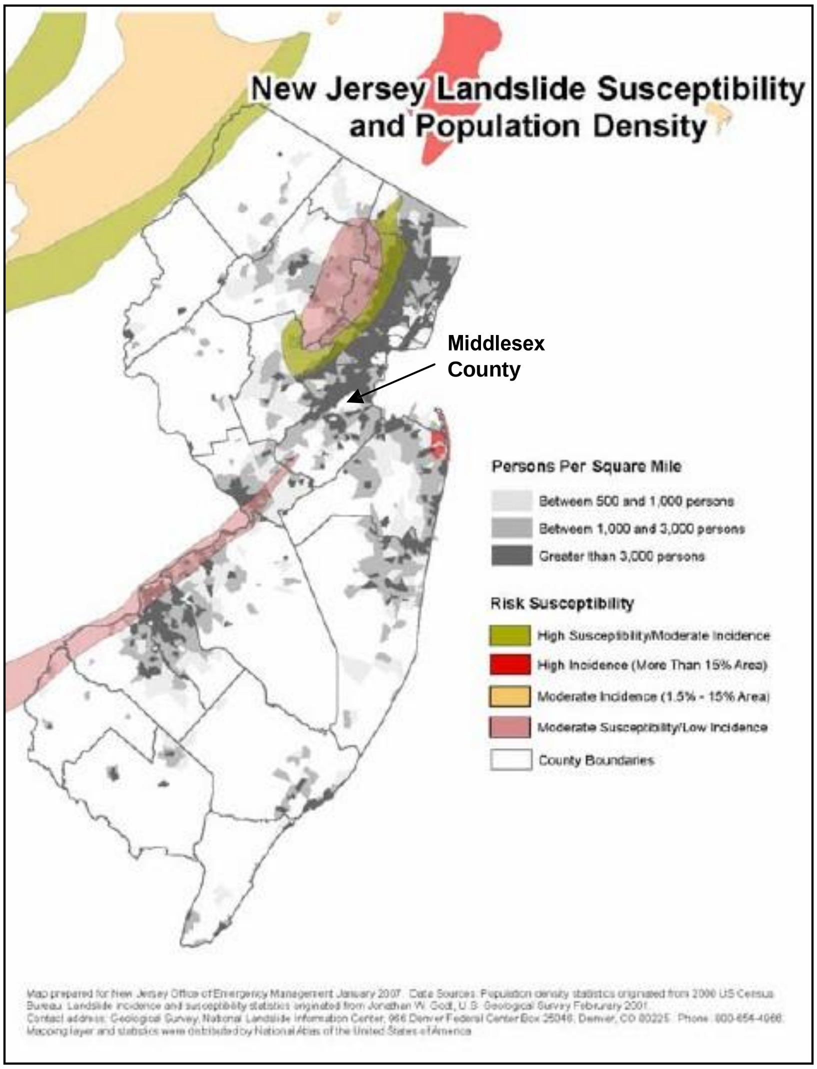
Landslides are considered highly site specific events and are concentrated in areas of steep slopes. The severity of the landslide hazard depends on a combination of slope angle and the geologic material underlying the slope.

[30] USGS, Landslide Types and Process, 2004

Impact on Life and Property

According to the New Jersey Landslide Susceptibility and Population Density map (Figure 6.3.14-2) developed by the NJGS, a small portion of southwestern Middlesex County is moderately susceptible to landslides. There are no known instances of injuries or death from past events in the county. Figure 6.3.14-2 is an overlay of population density (in gray shades) and landslide susceptibility. In Middlesex County the landslide susceptibility is considered low. Given these factors, it is reasonable to presume that impacts on life and property will continue to be minimal, although future development must avoid areas where the hazard is present.

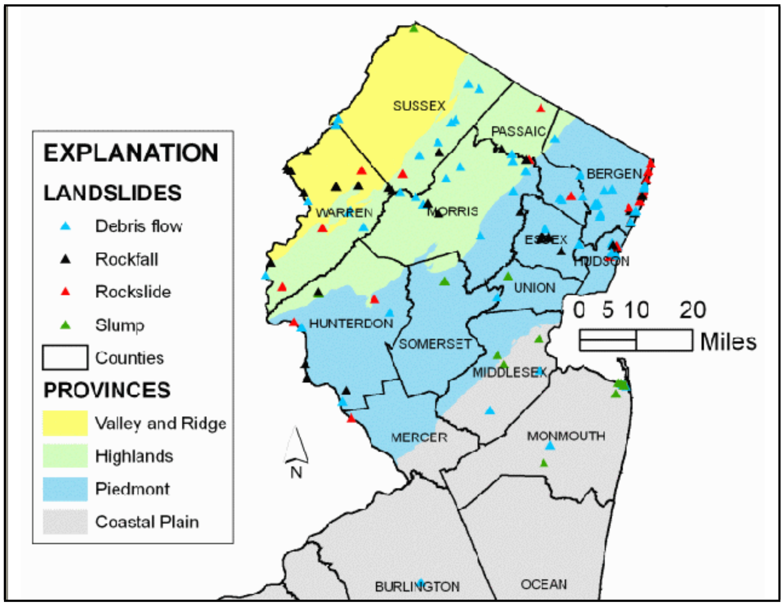
Figure 6.3.14-2
Landslide Susceptibility and Population Density in New Jersey
(Source: New Jersey Geologic Survey)



Occurrences of the Landslide Hazard

The New Jersey Geologic Survey (NJGS) indicates there have been 160 landslides in New Jersey. All of these events have occurred in the northern part of the state. In Middlesex County a total of five landslides have occurred since 1950. There have been three landslides categorized as slumps and two debris flows.

Figure 6.3.14-3
Landslides in Northern New Jersey
(Source: New Jersey Geological Survey)



Landslide probabilities are largely a function of surface geology, but are also influenced by both weather and human activities, as noted above. Based on the data from the NJGS on average Middlesex County has experiences a landslide event about every 11 years. The probability of future landslides having a significant impact on property and life in the planning area is considered low.

6.3.15 Severe Storm - Lightning

Description of the Lightning Hazard

Lightning events are generated by atmospheric imbalance and turbulence due to a combination of conditions. Lightning, which occurs during all thunderstorms, can strike anywhere. Generated by the buildup of charged ions in a thundercloud, the discharge of a lightning bolt interacts with the best conducting object or surface on the ground. The air in the channel of a lightning strike reaches temperatures higher than 50,000° F. See Appendix D for a more detailed description of the lightning hazard.

Location of the Lightning Hazard

Lightning occurs over the entire planning area, particularly during the spring and summer months. .

Severity of Lightning Hazard

Severe lightning events can occur in the planning area. Even during common events, the lightning current can branch off to strike a person from a tree, fence, pole, or other tall object. In addition, electrical current may be conducted through the ground to a person after lightning strikes a nearby tree, antenna, or other tall object. The current also may travel through power lines, telephone lines, or plumbing pipes to a person who is in contact with an electric appliance, telephone, or plumbing fixture. Lightning may use similar processes to damage property or cause fires.

Impact on Life and Property

About 100 deaths and 500 injuries are reported annually across the US from this hazard. In Middlesex County there were no deaths, two injuries, and approximately $503,000 in property damages related to lightning from 1950 to 2007. The reasonably low property damages and low injury/death rate from previous lightning events points to a relatively low vulnerability for lightning hazards in the planning area. See Tables 6.3.15-1 and 6.3.15-2 below.

Table 6.3.15-1:
Property Damage from Lightning, Middlesex County, 1950 – 2007
(Source: NOAA/NCDC)

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Woodbridge	07/18/1997	06:35 PM	Lightning	N/A	0	0	100K	0
2 South Plainfield	06/11/2001	10:30 PM	Lightning	N/A	0	0	200K	0
3 East Brunswick	06/11/2001	11:30 PM	Lightning	N/A	0	0	10K	0
4 East Brunswick	07/07/2001	11:10 PM	Lightning	N/A	0	0	25K	0
5 New Brunswick	07/10/2001	06:45 PM	Lightning	N/A	0	0	15K	0
6 Deans	08/27/2001	03:45 PM	Lightning	N/A	0	0	2K	0
7 Cranbury	07/19/2002	05:45 PM	Lightning	N/A	0	0	50K	0
8 Perth Amboy	08/17/2003	05:25 PM	Lightning	N/A	0	0	50K	0
9 Woodbridge	07/29/2007	12:05 PM	Lightning	N/A	0	0	50K	0K
10 Metuchen	08/08/2007	04:20 AM	Lightning	N/A	0	0	1K	0K
				TOTALS:	0	0	503K	0

Note: See bullets following Table 6.3.5-1 for column heading definitions.

Table 6.3.15-2:
Reported Injuries from Lightning, Middlesex County, 1950 – 2007
(Source: NOAA/NCDC)

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 New Brunswick	08/02/2002	07:40 PM	Lightning	N/A	0	1	0	0
2 Edison	08/17/2007	17:20 PM	Lightning	N/A	0	1	0K	0K
				TOTALS:	0	2	0	0

Note: See bullets following Table 6.3.5-1 for column heading definitions.

Occurrences of the Lightning Hazard

There were 28 instances of lightning reported in the NCDC database for Middlesex County from 1994 to 2007. Based on previous occurrences, the probability of future lightning events in Middlesex County is slightly more than two events per year, although the probability of less significant, thunderstorm-related events is clearly very high, even on an annual basis.

6.3.16 Severe Storm - Winter Weather

Description of the Winter Weather Hazard

Winter storms bring various forms of precipitation that occur only at cold temperatures, such as snow, sleet, or a rainstorm where ground temperatures are cold enough to allow icy conditions. These cold weather storms can also take the form of freezing rain or a wintry mix (See Section 6.3.13 for a discussion of the Ice Storm hazard).

Heavy snowfall and extreme cold can immobilize an entire region. Even areas that normally experience mild winters can be hit with a major snowstorm or extreme cold. Winter storms can result in flooding, storm surge, closed highways, blocked roads, downed power lines and hypothermia. See Appendix D for a more detailed description of winter weather hazard.

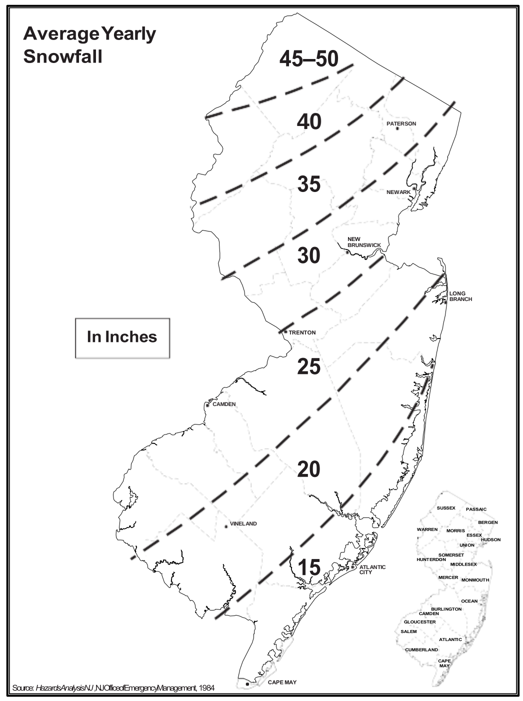
Figure 6.3.16-1
Heavy Snow from the 1993 Storm of the Century
(Source: Popular Mechanics - Science)

Location of the Winter Storm Hazard

The potential for winter storms is uniform for the entire planning area. All people and assets are considered to have the same degree of exposure.

Seasonal snowfall in New Jersey varies from an average of about 15 inches at Atlantic City to about 50 inches in Sussex County. There is, however, significant variation from year to year. February is the month when maximum accumulations on the ground are usually reached. In Middlesex County the average yearly snowfall is between 25 and 30 inches.

Figure 6.3.16-2
Average Annual Snowfall in New Jersey
Source: NJ Office of Emergency Management



Severity of Winter Storm Hazard

Although the NCDC database has not categorized any previous storms in Middlesex County as blizzards, this is perhaps the most severe type of winter storm, characterized by low temperatures, strong winds, and heavy blowing snow. The NCDC database query results include winter storm events between 1994 and 2007. In mid-March 1993, the eastern US experienced one of the most intense winter storms on record. The event, known as the "storm of the century" caused blizzard conditions throughout most of New Jersey dumping as much as three feet of snow in some parts of the State.

Impact on Life and Property

The NCDC reports there have been 39 injuries and one death due to snow and ice conditions. Approximately $19 million has been reported in property damages related to winter storms.

Table 6.3.16-1:
Winter Storm Events Resulting in Property Damage, Middlesex County, 1950 – 2007
(Source: NOAA/NCDC)

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 NJZ001 - 007>010 - 012>015	02/16/2003	03:00 PM	Heavy Snow	N/A	1	8	8.0M	0
2 NJZ001 - 007>008 - 010 - 012>015	01/22/2005	11:00 AM	Heavy Snow	N/A	0	0	11.0M	0
				TOTALS:	1	8	19.000M	0

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

Table 6.3.16-2:
Injury-Related Winter Storm Events, Middlesex County, 1950 – 2007
(Source: NOAA/NCDC)

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 NJZ001 - 007>010 - 012 - 015 - 019	01/13/1999	03:00 PM	Winter Storm	N/A	0	25	0	0
2 NJZ001 - 007>010 - 012>015	02/16/2003	03:00 PM	Heavy Snow	N/A	1	8	8.0M	0
3 NJZ012 - 015	03/16/2007	06:00 AM	Winter Weather	N/A	0	2	0K	0K
4 NJZ012 - 015	03/16/2007	06:00 AM	Winter Weather	N/A	0	2	0K	0K
5 NJZ012	12/13/2007	08:45 AM	Ice Storm	N/A	0	1	0K	0K
6 NJZ012	12/13/2007	08:45 AM	Ice Storm	N/A	0	1	0K	0K
				TOTALS:	1	39	8.000M	0

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

Occurrences of the Winter Weather Hazard

Winter storms occur frequently enough in Middlesex County to be a threat to people and property. Generally, the winter storm season in Middlesex runs from December to March. In Middlesex County the NCDC reports there have been 94 snow and ice events between 1950 and 2007. Although the query results begin in 1950 the first reported event is in 1994. It is unclear why the database does not include any events prior to 1994. The probability of winter storms occurring in the future is relatively high, based on previous data. See Table 6.3.16-3 below. On average, six winter storms occur every year in Middlesex County.

Table 6.3.16-3:
Summary of Notable Winter Storm Events impacting Middlesex County
(Source: NOAA, National Weather Service)

Date(s)	Storm Type	Description
February 7, 1978	Blizzard	This blizzard caused an estimated $24 million in damage Statewide, primarily to dunes, beaches, and public facilities along the beachfront.
March 13, 1993	Blizzard	Event know as the "Storm of the Century" affected as many as 26 States from Florida to Maine, the Gulf Coast, and the Ohio Valley. One of the most intense nor'easters to ever effect the United States. The "storm of the Century" label was given to the event due to the record low pressure, wind speeds, temperature and snowfall. All 21 counties in New Jersey were included in the Presidentially Declared Disaster. In Middlesex County snowfall totals ranged from 12-14 inches.
January 7, 1996	Blizzard	A State of Emergency was declared for the blizzard that hit the State. Road conditions were dangerous due to the high winds and drifts. Both government and contract snow plowing operations were running at a maximum. Local roads were impassable. This blizzard also brought on coastal flooding with the high tides of Sunday evening and Monday morning, and there were reports of damage to dunes and beaches from the heavy wave activity. More than 400 National Guard personnel were activated for transport assistance, primarily for medic missions. In Middlesex County snowfall totals ranged from 19-32 inches.
February 16, 2003	Snow Storm	The combination of the very cold temperatures and the approach of a strong storm system caused widespread snow to break out, starting before sunrise on Sunday, February 16th. Snow continued during the day Sunday, heavy at times, and continued into Sunday night. Precipitation continued on Monday, before finally coming to an end on Tuesday. Total snowfall in the county ranged from 12 to 24 inches. The President's Day snowstorm tied or set records in all 21 New Jersey counties, and all municipalities were involved in states of emergency. New Jersey requested and was granted a Snow Emergency Declaration.

6.3.17 Storm Surge

(Includes Hurricane, Nor'easter, Coastal Storm)

Description of the Storm Surge Hazard

Storm surges occur with coastal storms caused by massive low-pressure systems with cyclonic flows that are typical of hurricanes. Storm surge is simply water that is pushed toward the shore by the force of the winds swirling around the storm. This advancing surge combines with the normal tides to create the hurricane storm tide, which can increase the mean water level 15 feet or more. In addition, wind driven waves are superimposed on the storm tide. This rise in water level can cause severe flooding in coastal areas, particularly when the storm tide coincides with the normal high tides[31].

Storm surges are particularly damaging when they occur at the time of a high tide, combining the effects of the surge and the tide. This increases the difficulty of predicting the magnitude of a storm surge since it requires weather forecasts to be accurate to within a few hours. See Appendix D for a more detailed description of the storm surge hazard.

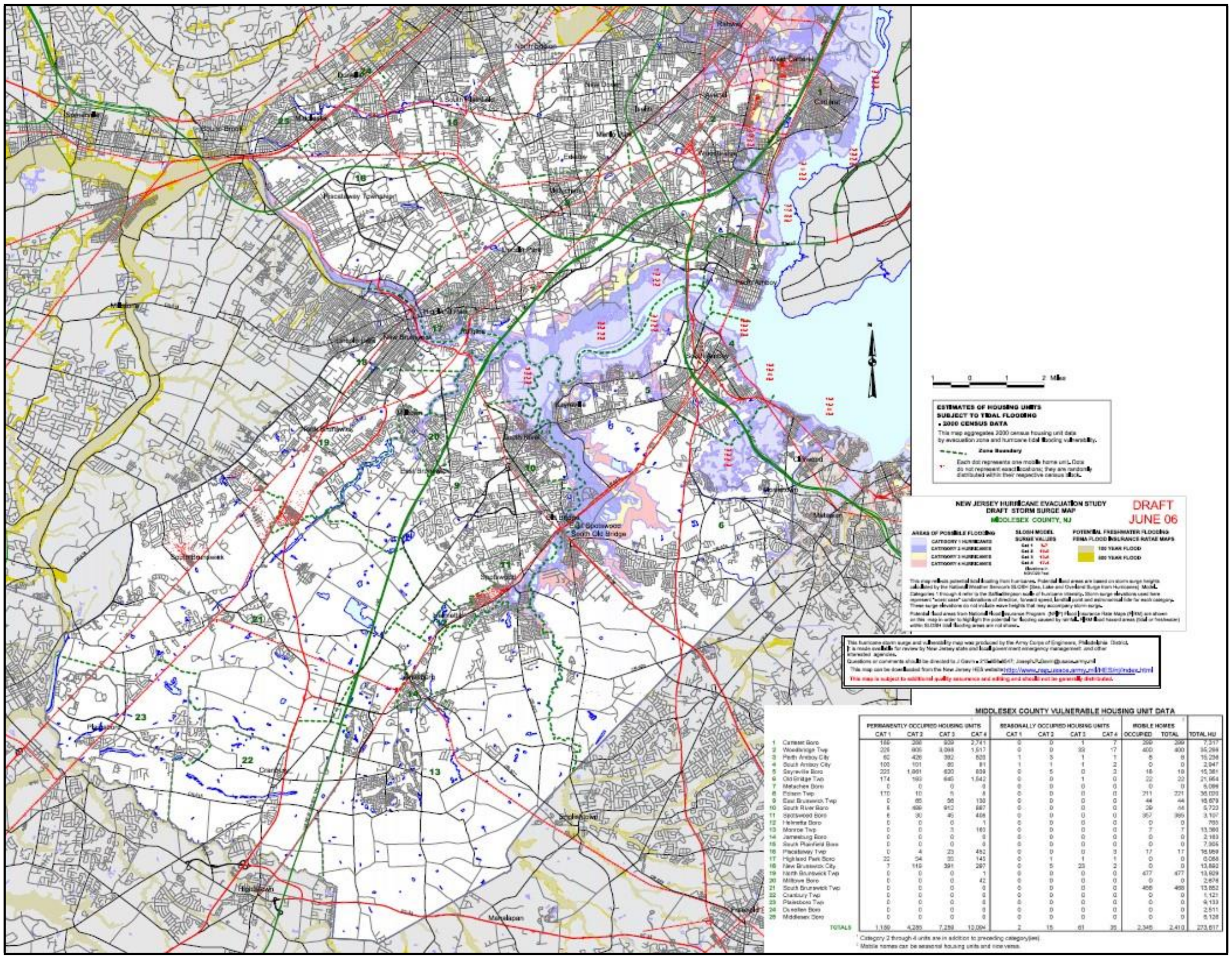
Location of the Storm Surge Hazard

The storm surge hazard associated with hurricanes and other severe storms are responsible for coastal flooding and erosion along the New Jersey coastline. The northeastern coastline of Middlesex County is at greatest risk from the storm surge hazard. In addition to flooding coastal areas, storm surge can also reach further inland impacting lakes and rivers. Storm surge in Middlesex County is primarily the result of hurricanes and nor'easters that travel north parallel to the Atlantic coastline.

In June of 2007, the USACE- Philadelphia Office and FEMA completed the *New Jersey Hurricane Evacuation Study Transportation Analysis*. The study provided New Jersey with updated local and regional hurricane evacuation clearance times for the 2007 Hurricane Season. The document included storm surge maps for each county in New Jersey. Figure 6.3.17-1 is the traffic evacuation zones and storm surge limits for the northeastern portion of Middlesex County.

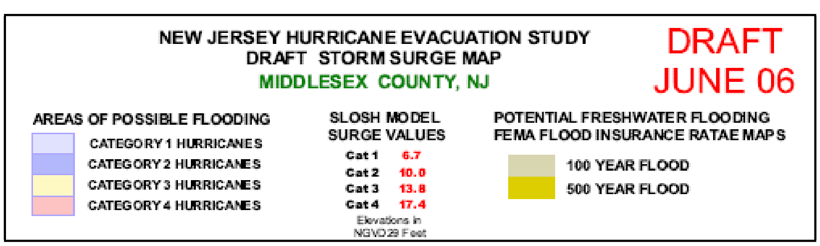
[31] NOAA

Figure 6.3.17-1
Middlesex County: Traffic Evacuation Zones and Storm Surge Limits
(Source: USACE)



The map is color coded to distinguish storm surge scenarios for hurricanes categories one through four and shows that areas following the Raritan and Arthur Kill Rivers are most susceptible to storm surge as high winds push water inland from the Raritan Bay. The legend is difficult to view at the current map scale is repeated below as a larger image.

Figure 6.3.17-2
Middlesex County: Legend Repeated from Storm Surge Limits Map
(Source: USACE)



Severity of the Storm Surge Hazard

Storm surges inundate coastal floodplains by tidal elevation rise in inland bays and ports, and backwater flooding through coastal river mouths. Severe winds associated with low-pressure systems cause increase in tide levels and water surface elevations. Storm systems also generate large waves that run up and flood coastal areas. The combined effects create storm surges that affect the beach, marsh, and low-lying floodplains. Shallow offshore depths can cause storm driven waves and tides to pile up against the shoreline and inside bays. See Table 6.3.17-1 for factors that can influence the severity of coastal storms.

Table 6.3.17-1:
Factors that Influence the Severity of Coastal Storms

Factor	Effect
Wind Velocity	The higher the wind velocity the greater the damage.
Storm Surge Height	The higher the storm surge the greater the damage.
Coastal Shape	Concave shoreline sections sustain more damage because the water is driven into a confined area by the advancing storm, thus increasing storm surge height and storm surge flooding.
Storm Center Velocity	Then slower the storm moves, the greater damage. The worst possible situation is a storm that stalls along a coast, through several high tides.
Nature of Coast	Damage is most severe on low-lying island barrier shorelines because they are easily over washed by wave action.
Previous Storm Damage	A coast weakened by even a minor previous storm will be subject to greater damage in a subsequent storm.
Human Activity	With increased development, property damage increases and more floating debris becomes available to knock down other structures.

Impact on Life and Property

In Middlesex County there have been no deaths or injuries due to storm surge. Approximately $900,000 has been reported in property damages related to storm surge.

Occurrences of the Storm Surge Hazard

The structure of the NCDC database combines coastal flooding and storm surge events into a category titled “Ocean and Lake Surf.” The database indicates there have been no storm surge events, 10 coastal flooding events, and one high-surf event to impact Middlesex County between 1950 and 2007. All of the events occurred between 1994 and 2007. The database does not provide any indication as to why there are no events listed prior to 1994.These events are summarized in Table 6.3.17-2 below.

Table 6.3.17-2:
Storm Surge Events, Middlesex County, 1950 – 2007
(Source: NOAA/NCDC)

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Coastal New Jersey	03/03/1994	0200	Coastal Flooding	N/A	0	0	0	0
2 NJZ012>014 - 024>026	05/11/1998	06:00 PM	Coastal Flooding	N/A	0	0	0	0
3 NJZ012>014 - 014 - 023>024 - 024>026	11/05/2002	07:00 AM	Coastal Flooding	N/A	0	0	0	0
4 NJZ012 - 014 - 023>026	01/03/2006	08:00 AM	Coastal Flood	N/A	0	0	0	0
5 NJZ012>014 - 020>026	01/31/2006	07:30 AM	Coastal Flood	N/A	0	0	0	0
6 NJZ012>014 - 020 - 022>027	02/12/2006	06:00 AM	Coastal Flood	N/A	0	0	900K	0
7 NJZ012 - 014 - 021 - 023>026	09/01/2006	01:00 PM	Coastal Flood	N/A	0	0	0	0
8 NJZ012>014 - 020	10/06/2006	07:00 AM	Coastal Flood	N/A	0	0	0K	0K
9 NJZ012>014 - 026	10/28/2006	09:00 AM	Coastal Flood	N/A	0	0	0K	0K
10 NJZ012 - 013	10/27/2007	07:00 AM	Coastal Flood	N/A	0	0	0K	0K
11 NJZ012 - 014 - 024	11/03/2007	05:00 AM	High Surf	N/A	0	0	0K	0K
				TOTALS:	0	0	900K	0

Note: Coded letters and numbers under Location or County column is a result of output from the NCDC query. See bullets following Table 6.3.5-1 for column heading definitions.

From the historical data provided in the NCDC database, the probability of storm surge occurring along the Atlantic coastline in the future is relatively low. No property damage, injuries or deaths is an indication that the future impact on life and property in the planning area will most likely be low.

6.3.18 Wildfire

Description of the Wildfire Hazard

Wildfires are uncontrolled fires often occurring in wildland areas, which can consume houses or agricultural resources if not contained. Wildfires/urban interface is defined as the area where structures and other human development blend with undeveloped wildland. See Appendix D for a more detailed description and definition of the wildfire hazard.

Location of the Wildfire Hazard

The potential for wildfires exists over the entire planning area, although the probability is relatively low because of the predominately urban nature of the planning area, as well as the detection and suppression capabilities that exist in the County.

Severity of the Wildfire Hazard

The frequency and severity of wildfires is dependent on weather and on human activity. In the planning area, severity has historically been very low, and duration a matter of hours to a day. The risk is increased and compounded by increasing development within the zone commonly referred to as the "urban-wildland interface." Within this zone of natural landscape, buildings become additional fuel for fires when fires do occur. Most wildland fires are man-caused and occur in the interface of developed lands and forest and range lands. In particular, the dry conditions, high temperatures, and low humidity that characterize drought periods set the stage for wildfires.

Impact on Life and Property

There are no records of deaths or injuries and no recorded loss of property from wildfires in the planning area.

Occurrences of the Wildfire Hazard

The NCDC database indicates there have been seven wildfires in Middlesex County since 1950. All seven events occurred between 2000 and 2005. These events are listed in the following table.

Table 6.3.18-1:
Wildfire Events, Middlesex County, 1950 – 2007
(Source: NOAA/NCDC)

Location or County	Date	Time	Type	Mag	Dth	Inj	PrD	CrD
1 Sayreville	04/29/2000	02:30 PM	Wild/forest Fire	N/A	0	0	0	0
2 Old Bridge	04/30/2000	02:30 PM	Wild/forest Fire	N/A	0	0	0	0
3 Cheesequake	04/27/2001	05:00 PM	Wild/forest Fire	N/A	0	0	0	0
4 Cheesequake	04/28/2001	01:00 PM	Wild/forest Fire	N/A	0	0	0	0
5 Cheesequake	04/29/2001	06:00 PM	Wild/forest Fire	N/A	0	0	0	0
6 Camp Kilmer	04/30/2001	02:15 PM	Wild/forest Fire	N/A	0	0	0	0
7 NJZ012	03/15/2005	12:00 PM	Wildfire	N/A	0	0	0	0
				TOTALS:	0	0	0	0

See bullets following Table 6.3.5-1 for column heading definitions.

Tables 6.3.18-2 and 6.3.18-3 below provide the most recent available data for the number of fire incidents in New Jersey per year and the number of acres burned, for the period 1996 to 2006. As shown in the tables, Middlesex County ranks tenth in average annual fire incidents and sixth in the number of acres burned per year. The same data is depicted graphically in Figures 7.3.6-1 and 7.3.6-2, following the tables. The past wildfire data indicates that the probability of future wildfires occurring in the planning area is relatively high, but will most likely have a limited impact on property and life in the planning area.

Table 6.3.18-2:
Number of Fire Incidents per Year by New Jersey County: 1996 to 2006
(Source: New Jersey Forest Fire Service)

County	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Totals	Annual Average
Atlantic	126	214	224	206	155	232	250	163	127	149	251	2,097	190.6
Bergen	1	7	8	8	6	13	4	5	5	5	10	72	6.5
Burlington	99	121	133	140	88	128	109	64	56	71	102	1,111	101.0
Camden	55	138	126	145	124	143	103	45	62	76	110	1,127	102.5
Cape May	59	86	71	84	50	92	80	40	62	52	55	731	66.5
Cumberland	93	151	206	173	100	140	102	58	88	111	117	1,339	121.7
Essex	0	0	0	0	0	0	0	0	1	0	2	3	0.3
Gloucester	34	67	53	72	36	73	78	23	28	68	67	599	54.5
Hudson	0	0	0	0	0	0	0	0	0	1	0	1	0.1
Hunterdon	21	37	28	69	44	66	41	26	14	30	48	424	38.5
Mercer	0	0	0	5	0	4	26	8	1	5	5	54	4.9
Middlesex	18	54	50	87	62	106	106	41	35	75	87	721	65.5
Monmouth	30	30	34	50	35	75	54	42	32	51	69	502	45.6
Morris	62	113	99	139	58	65	87	63	48	53	86	873	79.4
Ocean	196	347	304	412	265	374	287	227	213	228	325	3,178	288.9
Passaic	17	37	50	71	29	61	39	21	13	22	43	403	36.6
Salem	22	36	47	24	10	38	37	15	14	16	20	279	25.4
Somerset	6	50	17	65	15	50	86	41	20	60	59	469	42.6
Sussex	38	137	109	176	85	162	129	102	49	47	101	1,135	103.2
Union	0	0	0	0	0	0	0	0	2	2	4	8	0.7
Warren	33	56	94	129	75	90	144	55	37	107	71	891	81.0
Total	**910**	**1,681**	**1,653**	**2,055**	**1,237**	**1,912**	**1,762**	**1,039**	**907**	**1,229**	**1,632**	**16,017**	**1,456.1**

Note:
(1) The number of incidents includes only those wildfires to which the NJ Forest Fire Service responded to in its designated response area. Numbers are rounded for clarity.

Table 6.3.18-3:
State of New Jersey Annual Number of Acres Burned* by Wildfires County: 1996 – 2006
(Source: New Jersey Forest Fire Service)

County	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Totals	Annual Average
Atlantic	130	2,150	136	188	189	166	206	88	51	55	138	3,497	**318**
Bergen	0.25	49	42	103	8	98	10	2	13	5	12	342	**31**
Burlington	130	282	121	12,857	340	215	57	26	22	26	225	14,301	**1,300**
Camden	61	265	220	171	283	279	806	382	34	404	106	3011	**274**
Cape May	33	69	30	54	178	60	32	26	23	51	57	613	**56**
Cumberland	149	138	222	290	514	994	78	50	52	119	182	2,788	**253**
Essex	0	0	0	0	0	0	0	0	0.25	0	21	21	**2**
Gloucester	44	134	117	173	36	110	111	12	8	359	114	1218	**111**
Hudson	0	0	0	0	0	0	0	0	0	25	0	25	**2**
Hunterdon	7	38	44	108	12	30	21	7	14	10	68	359	**33**
Mercer	0	0	0	4	0	60	19	1	0.25	2	2	88	**8**
Middlesex	26	99	145	196	78	279	118	124	38	117	796	2,016	**183**
Monmouth	81	22	30	33	20	30	24	18	35	26	35	354	**32**
Morris	58	422	37	102	25	52	63	42	25	56	64	946	**86**
Ocean	136	1,023	138	712	123	1,806	4,089	109	141	95	240	8,612	**783**
Passaic	32	18	35	77	16	24	16	32	3	14	106	373	**34**
Salem	58	74	62	37	40	19	30	6	17	13	486	842	**77**
Somerset	2	30	6	164	5	43	32	9	9	26	19	345	**31**
Sussex	17	69	62	84	99	165	112	28	15	45	106	802	**73**
Union	0	0	0	0	0	0	0	0	.5	0.75	1	2	**0**
Warren	51	23	20	1,058	98	32	43	6	19	66	28	1,444	**131**
Total	**885**	**2,755**	**1,331**	**16,223**	**1,875**	**4,296**	**5,661**	**880**	**469**	**1,460**	**2,668**	**42000**	**3,818**

Figures 6.3.18-1 and 6.3.18-2 summarize by County the average annual wildfire incidents and acres burned in New Jersey between 1996 and 2006. The New Jersey Forest Fire Service indicates there has been an average of 65.5 wildfire incidents per year in Middlesex County between 1996 and 2006. During this same time period, an average of 183 acres burned per year in Middlesex County.

Figure 6.3.18-1
Average Annual Wildfire Incidents in New Jersey, 1996 – 2006
(Source: New Jersey Forest Fire Service)

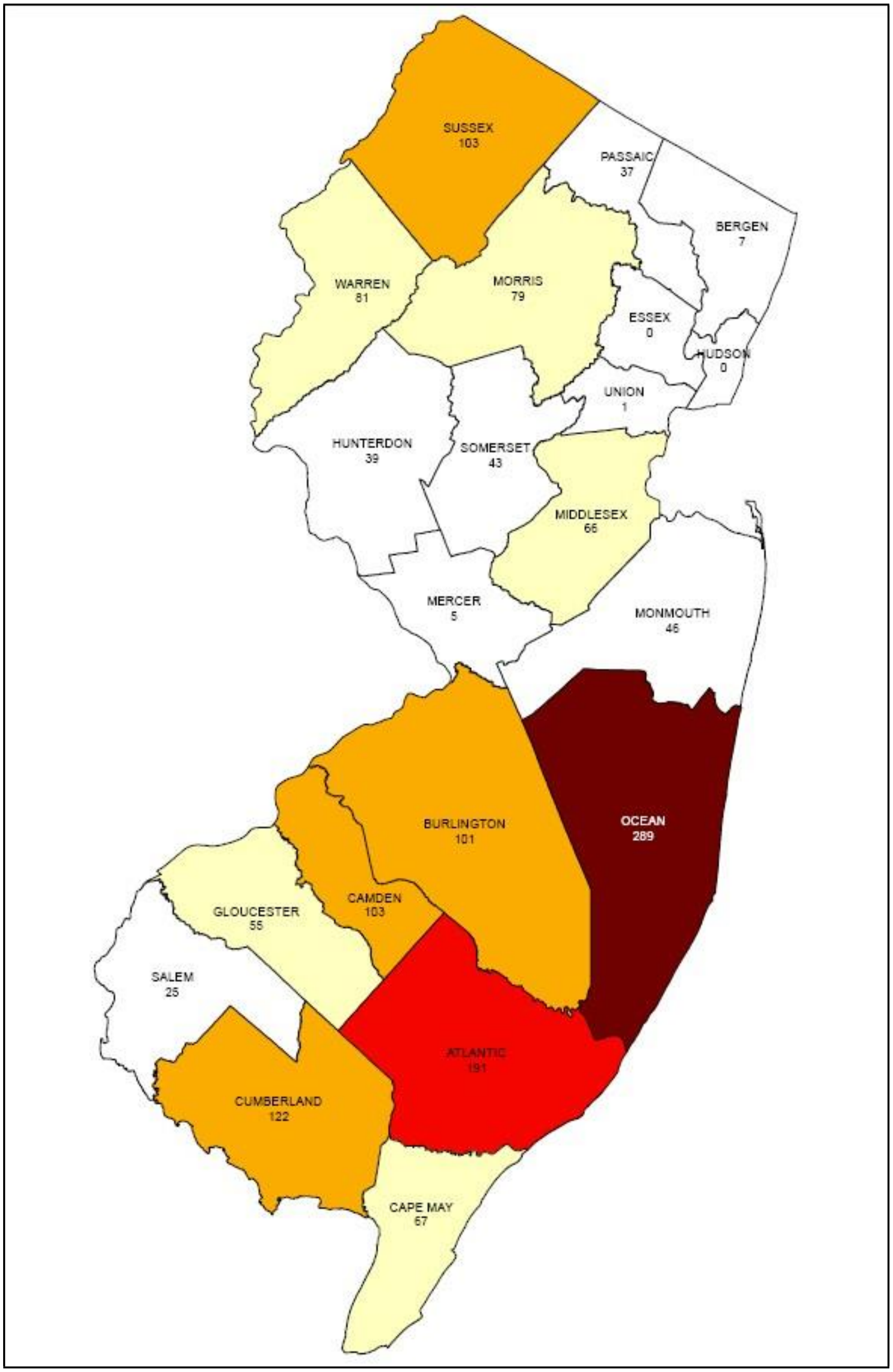
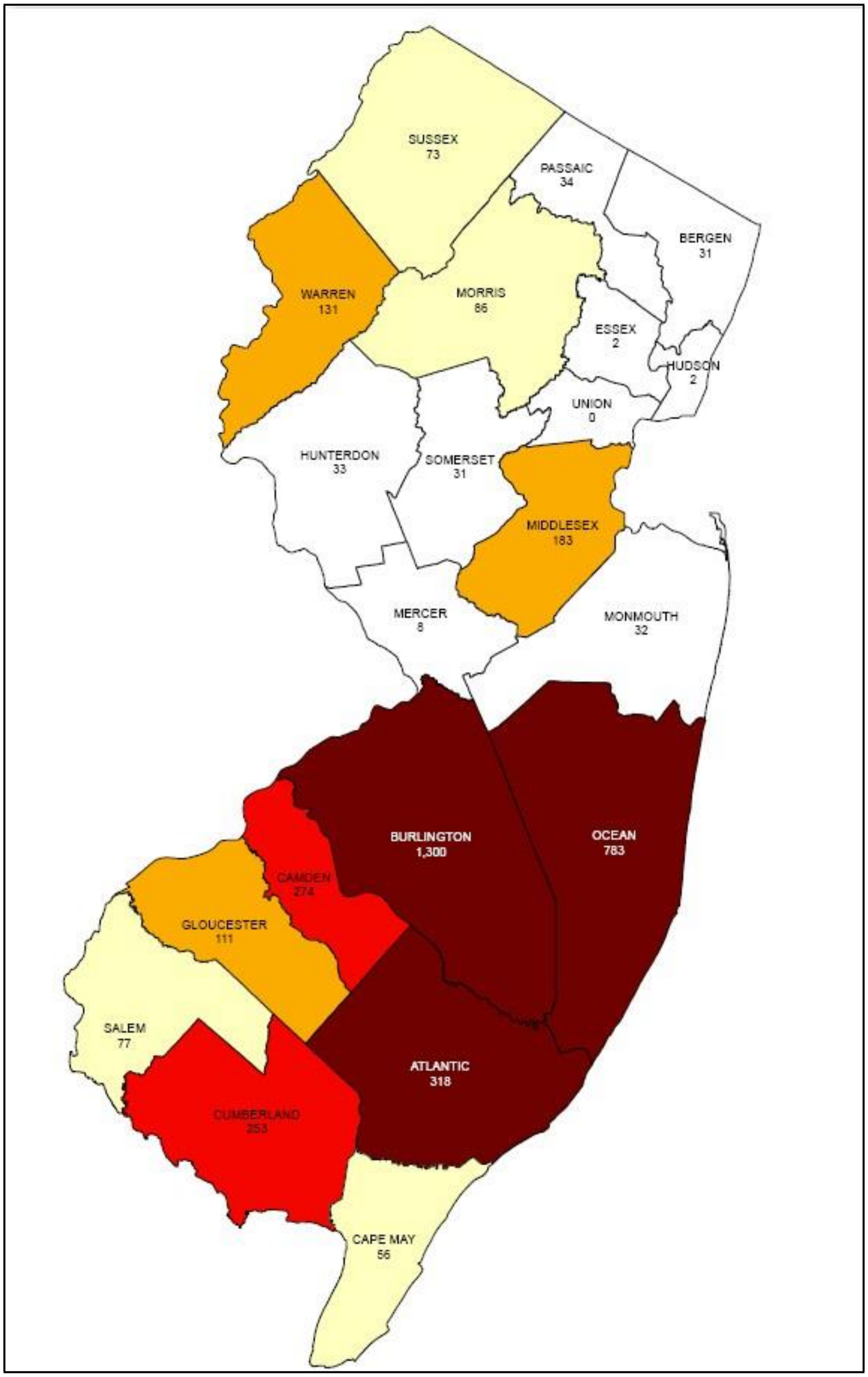


Figure 6.3.18-2
Average Annual Acres Burned from Wildfires in New Jersey, 1996 – 2006
(Source: New Jersey Forest Fire Service)



6.4 Identifying Hazards of Concern

The table on the following pages lists the hazards, describes the rationale for identifying (or not identifying) hazards as significant, shows sources of information that were consulted for the determination.

It also indicates the hazards identified by Middlesex County's HMSC for a detailed risk assessment.

Table 6.4-1:
Middlesex County Hazard Identification

Hazard	Identified Natural Hazard?	Rationale	Sources	Detailed Risk Assessment?
Flood	Yes	Widespread impacts, history of occurrences in the County, significant annual damages	FEMA Flood Insurance Studies, FEMA Flood Insurance Rate Maps, FEMA Public Assistance records, FEMA National Flood Insurance Program claims data, US Army Corps of Engineers (USACE), and National Oceanographic and Atmospheric Administration (NOAA), studies and records.	Yes
High Wind - Straight Line winds (Includes: Hurricane, Nor'easter, Tropical Storm, and Severe Storm)	Yes	▪ Hurricanes: Relatively low historic probability; potential for widespread impacts. ▪ Tropical Storms: Low to moderate probability; potential for widespread impacts ▪ Nor'easters: Moderate probability of more extreme events, potential for moderately widespread impacts. ▪ Severe Storms: High probability of occurrences, but losses are typically limited	NOAA and National Climatic Data Center (NCDC) records, New Jersey Department of Community Affairs - Division of Codes and Standards, New Jersey State Climatologist (Rutgers)	Yes

Hazard	Identified Natural Hazard?	Rationale	Sources	Detailed Risk Assessment?
Severe Storm - Winter Weather	Yes	High annual probability, widespread impacts, but losses generally limited except in most extreme events.	NOAA, NCDC, National Weather Service (NWS), New Jersey State Climatologist (Rutgers)	Yes
Earthquake / Geological	Yes	Relatively low annual probability, but potential for significant consequences.	United States Geologic Survey (USGS), New Jersey Geologic Survey (NJGS).	Yes
Hazardous Material Releases - Fixed Sites	Yes	High annual probability with impacts potentially severe in site specific areas.	US Environmental Protection Agency, FEMA HAZUS (Hazards US) software, the Right-to-Know (RTK) Network, US Environmental Protection Agency (EPA).	Yes
Hazardous Material Releases - Transportation	Yes	Moderate to high annual probability, but impacts limited in severity and area.	The RTK Network – Emergency Response Notification System (ERNS)	Yes
High Wind - Tornado	Yes	High annual probability, widespread impacts, but losses generally limited except in most extreme events.	NOAA -NCDC,, New Jersey State Climatologist (Rutgers), National Weather Service	No
Storm Surge - Hurricane/ Nor'easter/ Coastal Storm	Yes	Relatively low probability, impacts limited to northeastern coastal areas	NOAA - NCDC,USACE	No
Dam Failure	No	Low annual probability based on historical data, but impacts potentially significant in site specific areas.	New Jersey Department of Environmental Protection (NJDEP) – Dam Safety and Flood Control.	No
Erosion - Hurricane/Nor'easter/ Coastal Storm	No	Relatively high annual probability, but impacts are limited to northeastern coastal areas.	NOAA, The New Jersey Beach Profile Network (NJBPN), USACE	No
Ice Storm	No	Low to moderate annual probability with impacts relatively limited	NOAA - NCDC, New Jersey State Climatologist (Rutgers), National Weather Service	No
Drought		High annual probability, but impacts generally limited.	NOAA – NCDC; New Jersey State Department of Agriculture NJDEP	No

Hazard	Identified Natural Hazard?	Rationale	Sources	Detailed Risk Assessment?
Extreme Temperature - Cold	No	Relatively high annual probability, but impacts are limited.	NOAA - NCDC, New Jersey State Climatologist (Rutgers), National Weather Service	No
Extreme Temperature - Heat	No	Relatively high annual probability, but impacts are limited.	NOAA - NCDC, New Jersey State Climatologist (Rutgers), National Weather Service	No
Hail	No	High annual probability but impacts are limited in severity and area	NOAA – NCDC, New Jersey State Climatologist (Rutgers), National Weather Service	No
Landslide (non-seismic)	No	Low probability with losses typically limited	NJGS	No
Severe Storm - Lightning	No	High annual probability, but impacts generally limited	NOAA –NCDC, New Jersey State Climatologist (Rutgers), National Weather Service.	No
Wildfire	No	High annual probability of site-specific events, but impacts generally limited	NOAA, New Jersey State Forest Fire Service, NJDEP.	No

Note: The data in this table is intended only to give a general sense of the significance of hazards in the County, relative to each other. See Appendix B (Section 6) for a complete listing of all sources.

As indicated above, six natural hazards were identified as hazards of concern. As the regulations indicate, all these identified hazards must be profiled, their vulnerability assessed, and mitigation actions developed for them.

- **Flood**
- **High Wind – Straight Line Winds**
- **Severe Storm - Winter Weather**
- **Earthquake / Geological**
- **High Wind – Tornadoes**
- **Storm Surge**

In addition, the HMSC recommended including four natural hazards in the more detailed risk assessments in Section 7: Flood, High-Wind-Straight-Line Winds, Severe Storm-Winter Weather, and Earthquake/Geological. Additionally, the HMSC recommended including the dam failure hazard as part of the more detailed risk assessment for Brainerd Lake Dam in Cranbury Township and the Green Street Dam in Woodbridge Township.

Note on consistency with the New Jersey State Hazard Mitigation Plan

As part of the process of developing the Middlesex County Hazard Mitigation plan, the planning team carefully reviewed the updated New Jersey State Hazard Mitigation Plan (SHMP), with the goal of ensuring consistency between the two documents, primarily in the areas of hazard identification, risk assessment and mitigation strategy. The SHMP comprises a shorter list of hazards (and does not include hazardous materials), but the most significant hazards statewide are part of both documents, and are generally prioritized in the same way.

Section 7
Risk Assessment

Contents of this Section

7.1 Interim Final Rule Requirement for Risk Assessments

Requirement §201.6(c)(2): *The plan shall include a risk assessment that provides the factual basis for activities proposed in the strategy to reduce losses from identified hazards. Local risk assessments must provide sufficient information to enable the jurisdiction to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.*

Requirement §201.6(c)(2)(ii): *[The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.*

Requirement §201.6(c)(2)(ii): *[The risk assessment]* ***must*** *also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged floods.*

Requirement §201.6(c)(2)(ii)(A): *The plan* ***should*** *describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area . .*

Requirement §201.6(c)(2)(ii)(B): *[The plan* ***should*** *describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate . .*

Requirement §201.6(c)(2)(ii)(C): *[The plan* ***should*** *describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

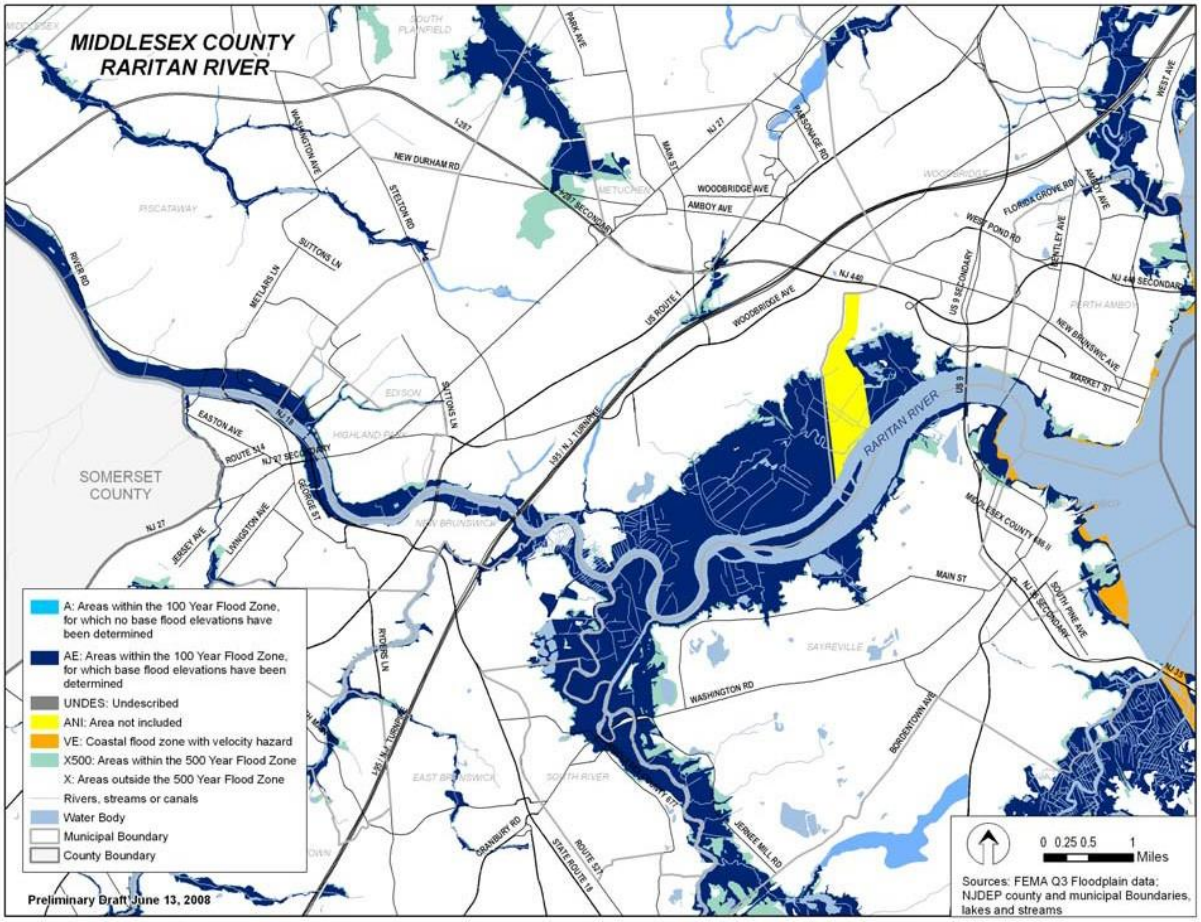
Requirement §201.6(c)(2)(iii): *For multi-jurisdictional plans, the risk assessment* ***must*** *assess each jurisdiction's risks where they vary from the risks facing the entire planning area.*

7.2 Overview and Analysis of Middlesex County's Vulnerability to Hazards

As discussed in Section 6 of this Plan (Hazard Identification), Middlesex County has at least some exposure to as many as 28 hazards, but most of them have such low probability that there is little or no serious risk to the County. Section 6 described the process by which the County reduced the list of 28 possible hazards to the six that create the most risk to Middlesex County's citizens, assets and operations: flood, high wind – straight line winds, severe storm - winter weather, earthquake (Geological) and hazardous materials releases (fixed sites and transportation). Additionally, the wildfire hazard was identified for certain municipalities.

This section addresses risks related to these six (6) predominant hazards, including estimates of potential future losses, in accordance with FEMA requirements. The most significant hazard to which Middlesex County is exposed to is flooding. The county has a well-established history of floods, mainly along the Raritan River and its tributaries. As discussed in more detail below (and in Section 6 of this Plan), the floodprone areas near the Raritan River are a combination of residential and commercial properties. Figure 7.2-1 below identifies the FEMA flood zones along a portion of the Raritan River in Middlesex County. In some areas of Middlesex Borough, the county has conducted limited activities to mitigate flood risk. The County's risk from the hazards high wind - straight line winds, severe storm - winter weather, earthquakes (Geological), and hazardous materials is less than for flood, so the risk calculations are somewhat less detailed than those related to floods.

Figure 7.2-1
Middlesex County Portion of the Raritan River
(Sources: FEMA and NJDEP)



7.3 Estimate of Potential Losses (Risk Assessment)

This section describes the risks to Middlesex County, including its citizens, residential, government and commercial assets from a set of pre-identified hazards. These include flooding, wind, winter storms and earthquakes. As noted above, risk is an expression of expected future monetary losses resulting from the impacts of natural hazards.

The Middlesex County Department of Planning indicated that, as of 1993, the entire county was comprised of approximately 337 square miles. The 1993 land use data was the most recent available data at the time of the Mitigation Plan update. Section 9 of this HMP includes a new action to update this information, although it is not likely to have changed. About 81 of the total 337 square miles in the County were categorized as developed land in 1993. The U.S. Census Bureau estimated that there were 288,590 housing units in Middlesex County as of 2008. Table 7.3-1 summarizes the number of square miles per land use category in Middlesex County.

Table 7.3-1
Middlesex County Estimated Land Use Inventory, 1993
(Source: Middlesex County Department of Planning)

Land Use Category	Square Miles
Residential	80.66
Commercial	13.53
Industrial	21.26
Recreational	27.31
Agricultural	41.88
Forested	82.55
Wetlands	70.28
Grand Total	**337.47**

7.3.1 Flood Risk in Middlesex County

This subsection of the Plan provides estimates of future flood losses, i.e. risk. Each of the loss calculations is based on best available data, but they must be considered estimates because highly detailed engineering were not performed as part of this planning process. The first subsection gives a general picture of the areas of various land uses in FEMA-designated flood zones in Middlesex County.

Background and Flood Vulnerability

Table 7.3.1-1 provides the estimated total acreage of Middlesex County's predominant asset classes in designated flood zones A through X (see flood zone descriptions below table). The total acreage of just under 115,000 is less than the entire county because some of the less significant asset classes such as wetlands and military installations are not shown. In addition to some of the categories being excluded, the flood zone for a small portion of Middlesex County is undefined, and therefore not included in the total.

Table 7.3.1-1:
Middlesex County: Land Area (Acres) of Predominant Asset Classes in Designated Flood Zones A through X
(Source: FEMA Q3 Floodplain Data per NJ Department of Environmental Protection)

Land Use/Flood Zone	A	AE	VE	X500	X	Total
Agriculture	286	646	0	301	16,295	17,528
Commercial	38	297	1	163	10,620	11,120
Industrial	93	982	27	809	10,160	12,072
Major Roadway	17	128	3	47	3,034	3,229
Residential	285	1,319	6	878	56,415	58,902
Transportation / Communication / Utilities	21	260	3	96	1,668	2,047
Urban	52	530	7	286	9,192	10,067
Grand Total	**792**	**4,162**	**47**	**2,580**	**107,385**	**114,965**

The flood zone designations are defined as follows

- **Zone A.** Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
- **Zone AE.** Areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage. In most instances, base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
- **Zone VE.** Coastal areas with a 1% or greater chance of flooding and an additional hazard associated with storm waves. These areas have a 26% chance of flooding over the life of a 30-year mortgage. Base flood elevations derived from detailed analyses are shown at selected intervals within these zones.
- **X500.** Areas between the limits of the 1% annual chance flooding and 0.2% chance flooding.
- **Zone X.** Areas outside the 1% annual chance floodplain and 0.2% chance floodplain, areas of 1% annual chance sheet flow flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding where the contributing drainage area is less than 1 square mile, or areas protected from the 1% annual chance flood by levees. No Base Flood Elevations or depths are shown within this zone[1].

Table 7.3.1-2 shows areas and values for various land uses in Middlesex County in FEMA-designated flood zones A and AE. The values of the agriculture, commercial, industrial and residential assets and contents were estimated based on data extracted from the FEMA HAZUS software in Fall, 2007. HAZUS was developed by FEMA, and is a risk assessment software program used to analyze potential losses from floods, hurricane winds and earthquakes. The HAZUS program uses current scientific and engineering knowledge coupled with the latest geographic information systems (GIS) technology to produce estimates of hazard-related damage before, or after, a disaster occurs[2] .

The figures should be considered estimates of values. The A and AE flood zone values were determined based on a percentage of the land use data. Note that the roadway value calculation is left out of the value columns because these cannot be identified through open-source methods, and because it is assumed they are not particularly susceptible to the effects of low-level floods. No specific building data was available for the transportation/communication/utilities and urban categories and therefore also not included in the value columns of the table.

[1] FEMA
[2] FEMA-HAZUS home page

Table 7.3.1-2:
Areas (in Acres) and Values for Various Middlesex County Asset Classes in Flood Zones A, AE, and X
(Source: FEMA Q3 Floodplain Data per NJDEP, HAZUS query - Fall 2007)

Land Use	Zones A and AE (Acres)	Asset Class Total (Acres)	% in A/AE Zone (Acres)	HAZUS (Total Value)	Value in A/AE Zone
Agriculture	932	17,528	5.32%	$160,080,000	$8,512,570
Commercial	335	11,120	3.01%	$15,578,542,000	$469,677,812
Industrial	1,075	12,072	8.91%	$5,654,748,000	$503,587,596
Major Roadway	145	3,229	4.48%	-------------	-------------
Residential	1,604	58,902	2.72%	$56,391,987,000	$1,535,297,766
Transportation / Communication / Utilities	280	2,047	13.70%	-------------	-------------
Urban	582	10,067	5.78%	------------	------------
Grand Total	**4,953**	**114,965**	**4.3%**	**-------------**	**--------------**

Method 1
Risk Estimate based on Area of Asset Classes in Various Flood Zones

The first method is to estimate the flood risk in Middlesex County using estimates of total acreage and value of structures in FEMA-identified flood zones, as shown above. As shown in Tables 7.3-1 and 7.3-2 above, the county has 4,953 acres of built area in FEMA A and AE flood zones, 2,580 acres in zone X500, and 107,385 acres in zone X. Zones A and AE are designated 100-year flood areas; i.e. they have at least a 1% annual chance of flooding. The X500-year column identifies the area between the 100-year and 500-year flood. The X designation indicates that a particular place is determined outside the 500-year floodplain. In order to estimate the risk to these assets, the total value of the asset classes in each flood zone is multiplied by the probability. For example,

$2,244,645 (residential/single-unit/low density) X 0.002 (500-year probability) = $4,489 (risk)

It is recognized that this method has some uncertainty because it does not contemplate that many structures in various flood zones are likely constructed in relatively safe areas based on past experience. However, it does offer a good proxy calculation to show the overall relative flood risk. Table 7.3.1-3 shows the estimated annual flood risk to these various asset classes.

Table 7.3.1-3:
Estimated Annual Flood Risk for Various Middlesex County Asset Classes in Flood Zones A and AE
(Source: FEMA Q3 Floodplain Data per NJDEP, HAZUS, RS Means)

Land Use	Asset Value s	Annual Risk	100-Year Risk
Agriculture	$8,512,570	$85,126	$1,214,743
Commercial	$469,677,812	$4,696,778	$67,023,023
Industrial	$503,587,596	$5,035,876	$71,861,949
Residential	$1,535,297,766	$15,352,978	$219,086,991
Total	**$2,517,075,744**	**$25,170,757**	**$359,186,708**

Method 2
Analysis of NFIP Repetitive Loss and Severe Repetitive Loss Data

The second risk assessment method is based on an analysis of National Flood Insurance Program (NFIP) data on repetitive flood loss and severe repetitive loss (SRL) properties. The NFIP defines repetitive loss properties as those that have submitted at least two insurance claims of more than $1,000 in a ten-year period. As of March, 2008, Middlesex County had 202 such properties, based on a query of the FEMA Bureaunet NFIP interface. Of these, 191 properties were residential and 11 were non-residential.

Residential Repetitive Loss Properties

Table 7.3.1-4 provides a summary of residential repetitive loss claims for communities within Middlesex County. The table includes the number of repetitive loss properties in each municipality, building and contents damages, the total number of claims, and the average claim amounts. As mentioned above, these figures are from an NFIP query performed in March of 2008 and include the April, 2007 floods.

Table 7.3.1-4:
Summary of Residential NFIP Repetitive Loss Statistics, Middlesex County, ordered by number of properties in each Municipality
(Source: FEMA NFIP query March, 2008)

Municipality Name	Properties	Building	Contents	Total	# Claims	Average
Middlesex, Borough of	79	$3,204,468	$503,339	$3,707,807	191	$19,413
South Plainfield, Borough	18	$374,237	$41,851	$416,088	41	$10,148
Dunellen, Borough of	17	$562,761	$75,320	$638,081	40	$15,952
Woodbridge, Township of	13	$1,152,432	$27,552	$1,179,984	32	$36,874
Piscataway, Township of	13	$905,884	$54,914	$960,798	31	$30,993
South River, Borough of	13	$226,315	$78,310	$304,625	34	$8,960
Helmetta, Borough of	10	$185,037	$3,560	$188,597	21	$8,981
Highland Park, Borough of	6	$120,766	$45,915	$166,681	17	$9,805
Carteret, Borough of	5	$45,598	$30,365	$75,963	10	$7,596
Edison, Township of	4	$122,696	$35,506	$158,202	11	$14,382
Monroe, Township of	4	$41,711	$6,228	$47,939	8	$5,992
East Brunswick, Township of	2	$54,229	$23,000	$77,229	4	$19,307
Old Bridge, Township of	2	$38,179	$11,267	$49,446	6	$8,241
Cranbury, Township of	1	$17,580	$200	$17,780	4	$4,445
New Brunswick, City of	1	$78,183	$0.00	$78,183	2	$39,092
Perth Amboy, City of	1	$27,203	24,694	$51,897	9	$5,766
Sayreville, Borough of	1	$5,204.70	$944	$6,149	2	$3,075
South Brunswick, Township of	1	$29,010.42	$608	$29,618	2	$14,809
Total	**191**	**$7,191,494**	**$963,575**	**$8,155,069**	**465**	**$17,538**

The data in Table 7.3-4 suggests relatively strong spatial patterns in flood risk in Middlesex County. Most of the flood risk appears to be concentrated in the communities of Middlesex, South Plainfield, and Dunellen. There is also moderate flood risk in the communities of Woodbridge, Piscataway, and South River. There are several patterns in this data that provide insight into residential flood risk in the county. First, for the communities with the highest flood risk there is a relatively large ratio between the amounts of the claims for building damages versus contents damages. To a degree this may be an artifact of the flood insurance policies, but it may also suggests that in these areas basements are being flooded, and that over time the owners have limited the amount of contents stored below grade because they are aware of the flood risk.

Non-Residential Repetitive Loss Properties

As noted earlier, as of March, 2008, Middlesex County had 11 non-residential repetitive loss properties in the NFIP database. Of these, three claimed no contents damage and two claimed no building damages. Table 7.3.1-5 below shows select data about flood losses on these sites. Individual addresses are omitted for reasons of confidentiality. The next table shows various data related to non-residential repetitive loss properties in the county.

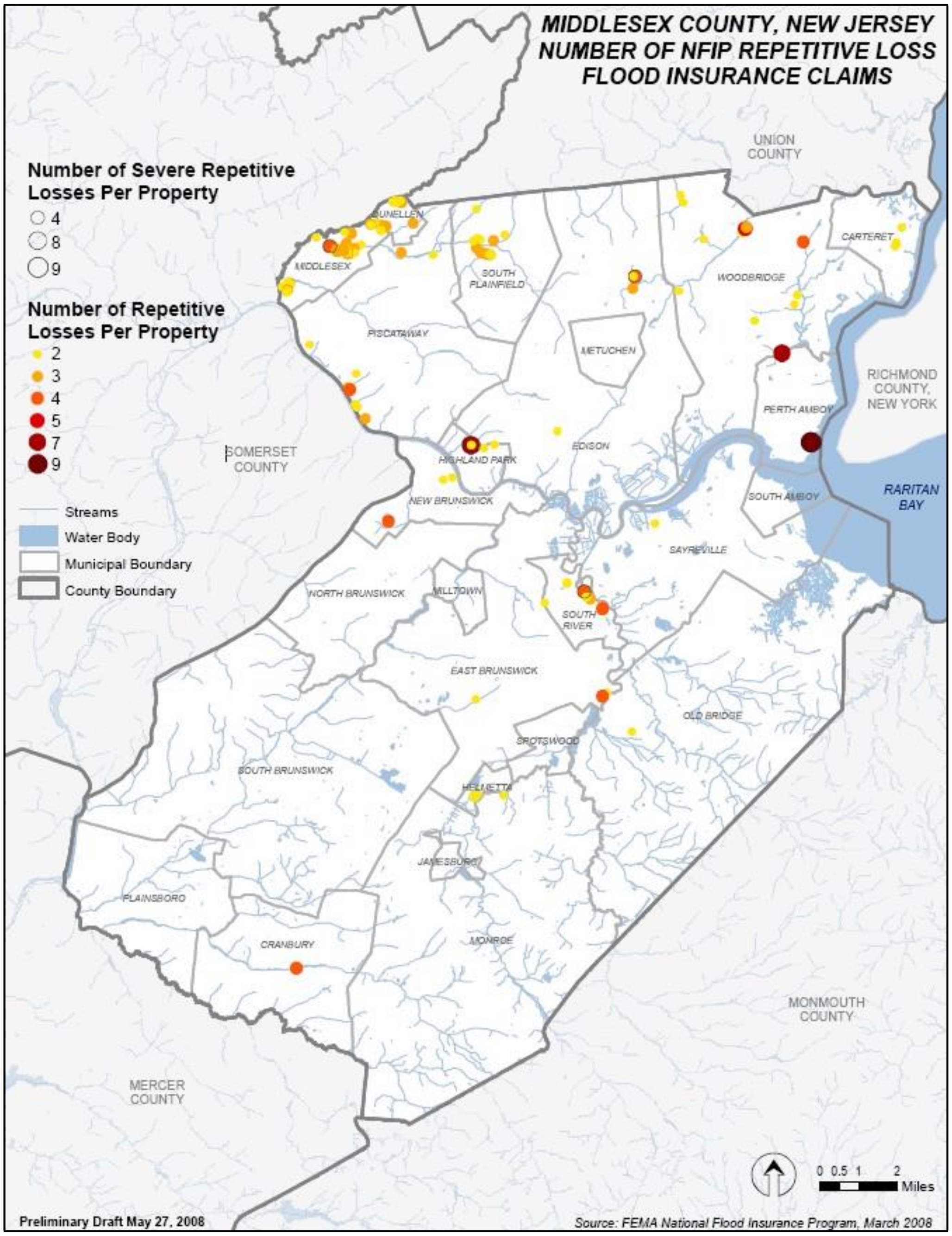
Table 7.3.1-5:
Summary of Non-Residential Repetitive Flood Loss Claims in Middlesex County
(Source: FEMA NFIP query March, 2008)

Municipality Name	Street Name	Building	Contents	Total	# Claims	Average
Edison, Township of	Oak Drive Roosevelt Park	$155,328	$14,269	$169,597	3	$56,532
Middlesex, Borough of	Bound Brook Road	$146,575	$42,465	$189,040	3	$63,013
Middlesex, Borough of	Bound Brook Road	$15,544	$0	$15,544	3	$5,181
New Brunswick, City of	Jersey Ave.	$303,195	$697	$303,892	4	$75,973
New Brunswick, City of	Livingston Ave.	$0	$19,570	$19,570	2	$9,785
Perth Amboy, City of	Kelsey Ave.	$63,922	$193,553	$257,475	7	$36,782
Piscataway, Township of	Williams St.	$113,571	$14,603	$128,174	3	$42,725
South Plainfield, Borough of	Front St.	$63,713	$0	$63,713	2	$31,856
South Plainfield, Borough of	New Market Ave.	$148,531	$33,349	$181,880	3	$60,627
Woodbridge, Township of	St. George Ave.	$0	$18,581	$18,581	2	$9,291
Woodbridge, Township of	Wood Ave S.	$225,000	$0	$225,000	2	$112,500
Total	**------------------**	**$1,235,379**	**$337,085**	**$1,572,464**	**34**	**$46,249**

The relatively small numbers and amounts of claims for these properties make it impossible to accurately determine an accurate annual value for flood losses. Because of this, it is also not possible to estimate losses over a longer time, such as the 100-year planning horizon that is used elsewhere in this section. If a risk projection is required in the future, it may be possible to use an approach based on site-specific survey and engineering information.

The series of maps below display information about the residential and non-residential repetitive flood loss insurance claims in Middlesex County. The first map (Figure 7.3.1-1) highlights the numbers of insurance claims by property. The second map (Figure 7.3.1-2) shows the cumulative amounts of insurance claims for the same properties.

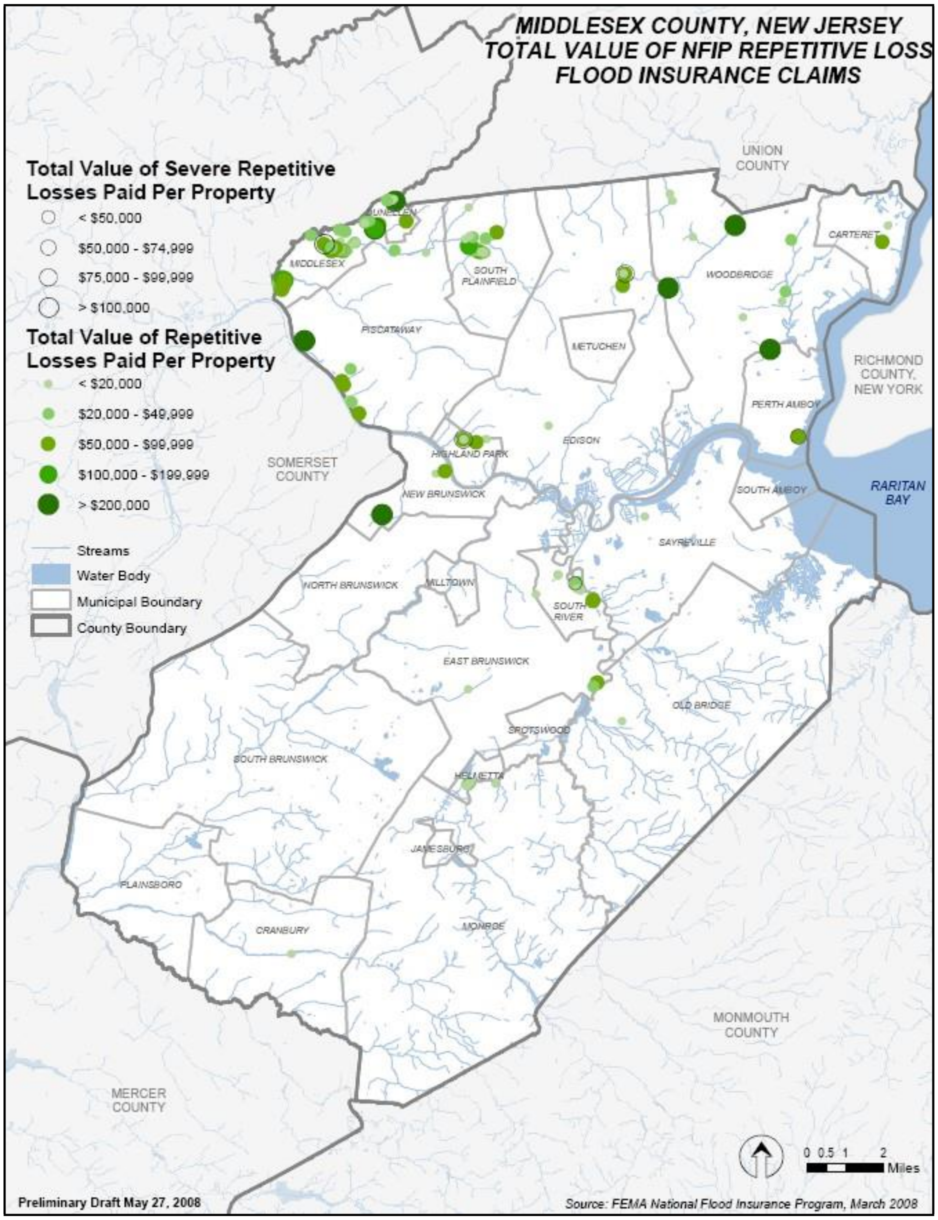
Figure 7.3.1-1
NFIP Repetitive Loss and SRL Flood Insurance Claims for Middlesex County
(Source: FEMA NFIP Query March 2008)



(1) 22 of the 202 repetitive loss property addresses were unable to be mapped. The unmapped properties are located in the Townships of Edison, Monroe, Spotswood, Piscataway, Little Egg Harbor, South River, and the Boroughs of Middlesex, Dunellen, Helmetta, and South Plainfield.

The following map highlights the total value per property of NFIP repetitive loss and SRL flood insurance claims in Middlesex County.

Figure 7.3.1-2
Value of NFIP Repetitive Loss and SRL Flood Insurance Claims for Middlesex County
(Source: FEMA NFIP Query March 2008)



(1) 22 of the 202 repetitive loss property addresses were unable to be mapped. The unmapped properties are located in the Townships of Edison, Monroe, Spotswood, Piscataway, Little Egg Harbor, South River, and the Boroughs of Middlesex, Dunellen, Helmetta, and South Plainfield.

The repetitive loss claims can be further broken down from listing by municipality to focusing on individual street level data. Table 7.3.1-6 provides a summary of residential repetitive loss claims for individual streets within Middlesex County. Address data about individual sites is omitted for reasons of confidentiality. The data displayed in the table summarizes the NFIP repetitive loss data for each of the individual streets in the County that includes a repetitive loss property. The data is combined for streets with multiple repetitive loss properties. The data shows that Middlesex Borough clearly has the most streets with multiple repetitive loss properties. Middlesex Borough includes seven of the top eight streets in the county with the most repetitive loss properties.

Table 7.3.1-6:
Summary of Residential NFIP Repetitive Loss Statistics, Middlesex County, ordered by number of Properties on each Street
(Source: FEMA NFIP query March, 2008)

Municipality Name	Street Name	Properties	Building	Contents	Total	Claims	Average
Middlesex, Borough of	2nd Street	9	$156,439	$12,422	$168,861	22	$7,675
Middlesex, Borough of	Raritan Avenue	9	$546,942	$162,897	$709,840	20	$35,492
Middlesex, Borough of	7th Street	8	$337,328	$106,817	$444,146	23	$19,311
Middlesex, Borough of	Bound Brook Road	7	$889,717	$9,425	$899,142	14	$64,224
Helmetta, Borough of	Railroad Avenue	6	$123,788	$3,560	$127,349	12	$10,612
Middlesex, Borough of	3rd Street	6	$131,741	$28,806	$160,547	12	$13,379
Middlesex, Borough of	1st Street	5	$125,105	$21,535	$146,640	11	$13,331
Middlesex, Borough of	Marshall Place	5	$152,315	$2,835	$155,150	13	$11,935
Piscataway, Township of	River Road	5	$351,543	$23,949	$375,492	13	$28,884
Dunellen, Borough of	N. Washington Avenue	4	$70,641	$7,428	$78,069	8	$9,759
Highland Park, Borough of	Harrison Avenue	4	$61,355	$25,487	$86,842	13	$6,680
Middlesex, Borough of	Rock Lane	4	$114,799	$34,129	$148,928	11	$13,539
Middlesex, Borough of	Cap Lane	4	$79,903	$17,817	$97,720	10	$9,772
Middlesex, Borough of	6th Street	4	$171,392	$40,076	$211,468	11	$19,224
Dunellen, Borough of	Mountain View Terrace	3	$55,497	$24,988	$80,486	7	$11,498
Dunellen, Borough of	Jackson Avenue	3	$224,776	$23,044	$247,819	7	$35,403
Middlesex, Borough of	5th Street	3	$90,829	$41,322	$132,151	8	$16,519
South Plainfield, Borough	Highland Avenue	3	$36,340	$6,616	$42,956	7	$6,137
South Plainfield, Borough	New Market	3	$42,435	$188	$42,623	6	$7,104
South River, Borough of	Causeway Street	3	$62,154	$24,324	$86,478	9	$9,609
Woodbridge, Township of	McFarlane Road	3	$1,011,752	$0	$1,011,752	10	$101,175
Woodbridge, Township of	Watson Avenue	3	$48,292	$5,359	$53,651	6	$8,942
Carteret, Borough of	Noe Street	2	$30,276	$29,546	$59,822	4	$14,955
Dunellen, Borough of	4th Street	2	$32,425	$1,295	$33,720	4	$8,430
Dunellen, Borough of	Front Street	2	$93,008	$14,246	$107,254	6	$17,876
Edison, Township of	Fishel Road	2	$52,051	$18,468	$70,519	6	$11,753
Helmetta, Borough of	Main Street	2	$39,442	$0	$39,442	5	$7,888

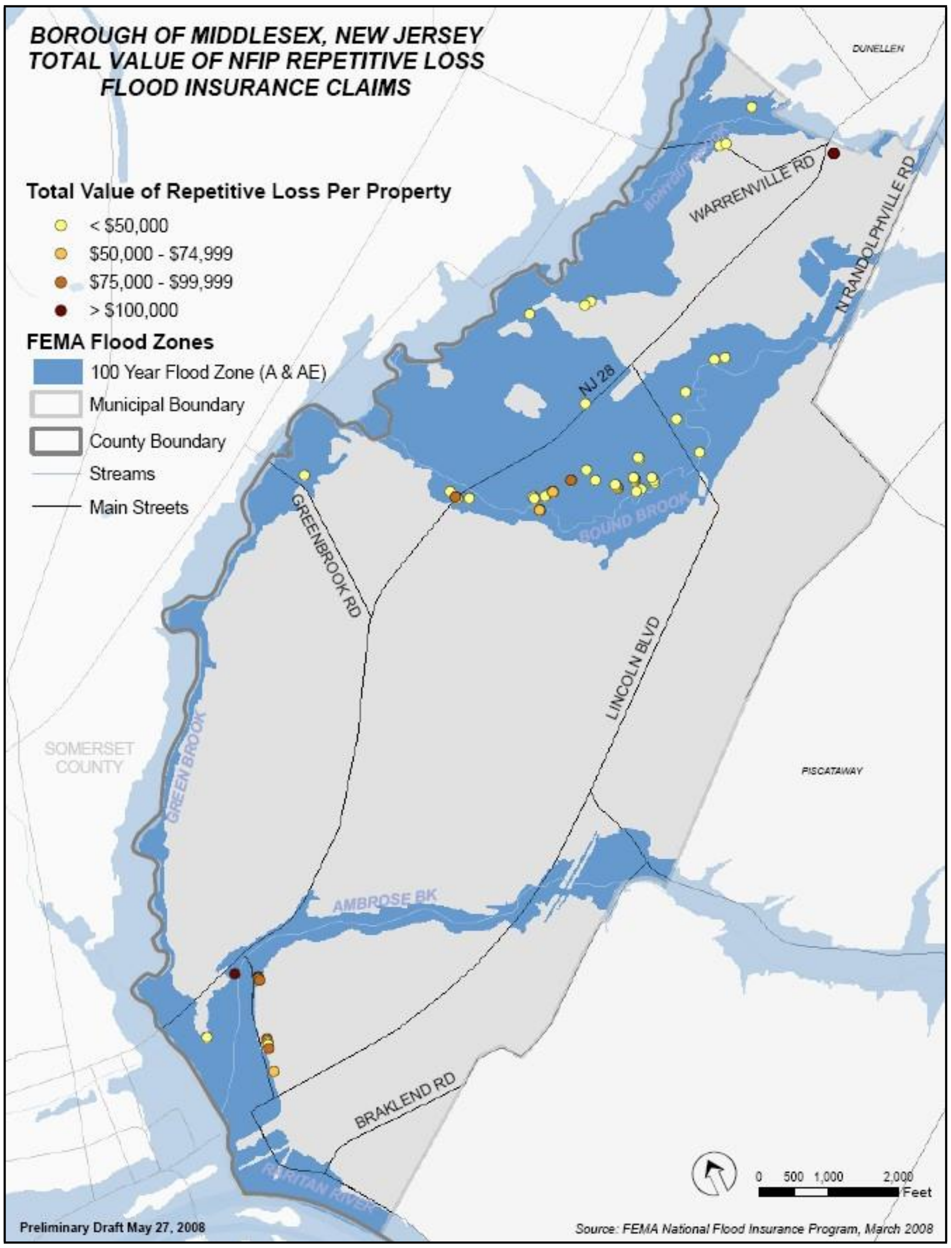
Municipality Name	Street Name	Properties	Building	Contents	Total	Claims	Average
Middlesex, Borough of	Lee Drive	2	$22,464	$10,582	$33,046	4	$8,261
Middlesex, Borough of	Lincoln Avenue	2	$25,603	$1,579	$27,182	5	$5,436
Middlesex, Borough of	John Street	2	$49,989	$1,649	$51,638	6	$8,606
South Plainfield, Borough	Elsie Avenue	2	$73,308	$728	$74,035	6	$12,339
South Plainfield, Borough	Carmine Avenue	2	$52,941	$9,840	$62,781	4	$15,695
South Plainfield, Borough	Sampton Avenue	2	$16,964	$0	$16,964	4	$4,241
South River, Borough of	Lee Street	2	$18,001	$1,013	$19,013	4	$4,753
South River, Borough of	Armstrong Avenue	2	$62,250	$29,767	$92,017	6	$15,336
South River, Borough of	Maple	2	$11,725	$8,227	$19,951	4	$4,988
Carteret, Borough of	Emerson Street	1	$3,675	$0	$3,675	2	$1,838
Carteret, Borough of	Harris Street	1	$5,157	$0	$5,157	2	$2,578
Carteret, Borough of	Charles Street	1	$6,490	$819	$7,309	2	$3,654
Cranbury, Township of	N. Main Street	1	$17,580	$200	$17,780	4	$4,445
Dunellen, Borough of	3rd Street	1	$4,159	$0	$4,159	2	$2,079
Dunellen, Borough of	Orange Street	1	$62,124	$4,320	$66,444	3	$22,148
Dunellen, Borough of	Dunellen Avenue	1	$20,132	$0	$20,132	3	$6,711
East Brunswick, Township of	Squire Street	1	$42,497	$23,000	$65,497	2	$32,748
East Brunswick, Township of	Yorktown Road	1	$11,732	$0	$11,732	2	$5,866
Edison, Township of	Marlin Avenue E.	1	$62,218	$17,038	$79,256	3	$26,419
Edison, Township of	Woodedge Avenue	1	$8,427	$0	$8,427	2	$4,213
Helmetta, Borough of	John Street	1	$17,477	$0	$17,477	2	$8,739
Helmetta, Borough of	Old Forge Road	1	$4,329	$0	$4,329	2	$2,164
Highland Park, Borough of	Highland Avenue	1	$5,963	$4,323	$10,286	2	$5,143
Highland Park, Borough of	Park Avenue	1	$53,449	$16,104	$69,553	2	$34,776
Middlesex, Borough of	4th Street	1	$25,026	$0	$25,026	3	$8,342
Middlesex, Borough of	W 2nd Street	1	$15,803	$3,016	$18,819	2	$9,409
Middlesex, Borough of	Prospect Place	1	$28,935	$0	$28,935	2	$14,468
Middlesex, Borough of	Union Avenue	1	$145,233	$0	$145,233	2	$72,616
Middlesex, Borough of	Starlit Drive	1	$29,723	$0	$29,723	2	$14,862
Middlesex, Borough of	Fulton Street	1	$11,516	$260	$11,776	3	$3,925
Middlesex, Borough of	Valley Brook Drive	1	$15,820	$5,204	$21,024	2	$10,512

Municipality Name	Street Name	Properties	Building	Contents	Total	Claims	Average
Middlesex, Borough of	Denton Place	1	$16,032	$0	$16,032	2	$8,016
Middlesex, Borough of	Warrenville Road	1	$21,813	$2,969	$24,782	3	$8,261
Monroe, Township of	Ashmall Avenue	1	$5,289	$0	$5,289	2	$2,644
Monroe, Township of	Spotswood Garvel Hill	1	$1,140	$5,311	$6,451	2	$3,225
Monroe, Township of	Carlton Avenue	1	$21,636	$917	$22,553	2	$11,277
Monroe, Township of	Union Hill Road	1	$13,646	$0	$13,646	2	$6,823
New Brunswick, City of	Richmond Street	1	$78,183	$0	$78,183	2	$39,092
Old Bridge, Township of	Darwin Road	1	$4,361	$2,843	$7,204	2	$3,602
Old Bridge, Township of	River Street	1	$33,819	$8,424	$42,242	4	$10,561
Perth Amboy, City of	Water Street	1	$27,204	$24,694	$51,898	9	$5,766
Piscataway, Township of	Lakeview Avenue	1	$16,856	$0	$16,856	2	$8,428
Piscataway, Township of	Rivercrest Road	1	$16,406	$6,304	$22,711	2	$11,355
Piscataway, Township of	Edwards Avenue	1	$21,015	$0	$21,015	3	$7,005
Piscataway, Township of	Birchview Drive	1	$257,556	$0	$257,556	2	$128,778
Piscataway, Township of	Sunset Road	1	$45,347	$24,662	$70,009	3	$23,336
Piscataway, Township of	Lots 3 Building K	1	$29,819	$0	$29,819	2	$14,909
Piscataway, Township of	Lots 3 Building L	1	$138,619	$0	$138,619	2	$69,309
Piscataway, Township of	Lots 3 Building M	1	$28,722	$0	$28,722	2	$14,361
Sayreville, Borough of	6th Street	1	$5,205	$945	$6,150	2	$3,075
South Brunswick, Township of	South Brunswick	1	$29,010	$608	$29,619	2	$14,809
South Plainfield, Borough	Morton Avenue	1	$9,142	$0	$9,142	2	$4,571
South Plainfield, Borough	Schillaci Lane	1	$25,391	$779	$26,170	2	$13,085
South Plainfield, Borough	Oakmoor Avenue	1	$25,238	$1,356	$26,594	3	$8,865
South Plainfield, Borough	Manning Avenue	1	$46,745	$12,274	$59,019	2	$29,510
South Plainfield, Borough	Anthony Avenue	1	$12,814	$10,069	$22,883	3	$7,628
South Plainfield, Borough	Atlantis Boulevard	1	$32,920	$0	$32,920	2	$16,460
South River, Borough of	Herman Street	1	$13,192	$450	$13,642	3	$4,547
South River, Borough of	Leroy Street	1	$6,688	$0	$6,688	2	$3,344
South River, Borough of	Levinson Avenue	1	$52,046	$10,186	$62,232	4	$15,558
South River, Borough of	Cleveland Avenue	1	$261	$4,343	$4,604	2	$2,302
Woodbridge, Township of	Edgerton Boulevard	1	$35,890	$7,386	$43,276	4	$10,819

Municipality Name	Street Name	Properties	Building	Contents	Total	Claims	Average
Woodbridge, Township of	Fleetwood Road	1	$10,173	$967	$11,140	2	$5,570
Woodbridge, Township of	N. Hill Road	1	$3,531	$10,403	$13,933	2	$6,967
Woodbridge, Township of	Brookside Court	1	$18,348	$3,436	$21,785	2	$10,892
Woodbridge, Township of	Jordan Road	1	$8,548	$0	$8,548	2	$4,274
Woodbridge, Township of	Middlesex Avenue	1	$5,558	$0	$5,558	2	$2,779
Woodbridge, Township of	Amherst Avenue	1	$10,341	$0	$10,341	2	$5,170
Total / Average	**-----------------**	**191**	**$7,191,494**	**$963,575**	**$8,155,069**	**465**	**$17,538**

The following three maps highlight the total value per property of NFIP repetitive loss flood insurance claims for the boroughs of Middlesex, South Plainfield, and Dunellen. Maps are shown for these boroughs based on the order of Table 7.3.1-4.

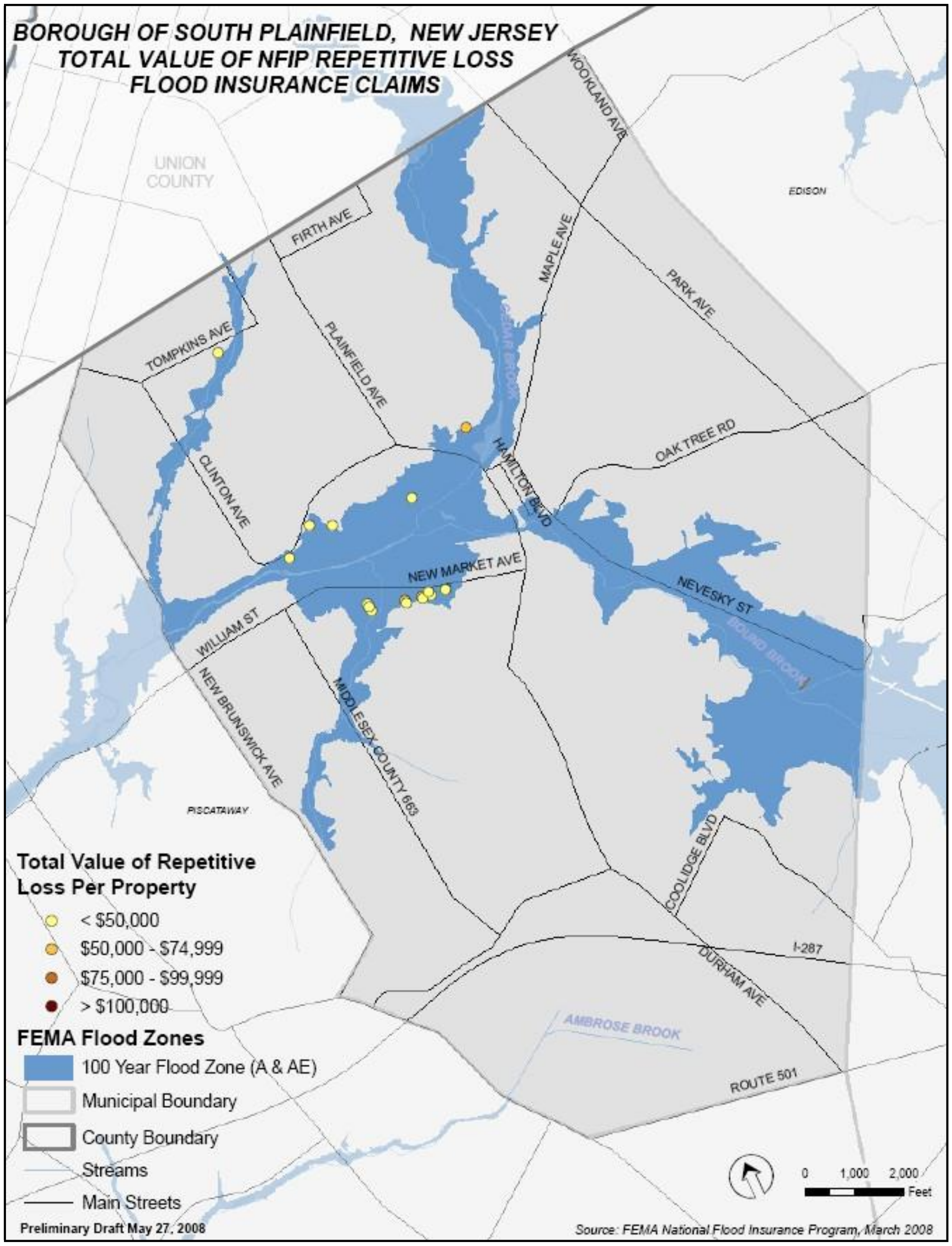
Figure 7.3.1-3
Value of NFIP Repetitive Loss Flood Insurance Claims for Middlesex Borough, New Jersey
(Source: FEMA Q3 Floodplain Data per NJDEP, and FEMA NFIP Query March 2008)



(1) Four of the 79 repetitive loss property addresses in Middlesex Borough were unable to be mapped, and therefore excluded.

The following map highlights the total value per property of NFIP repetitive loss flood insurance claims in South Plainfield Borough, New Jersey.

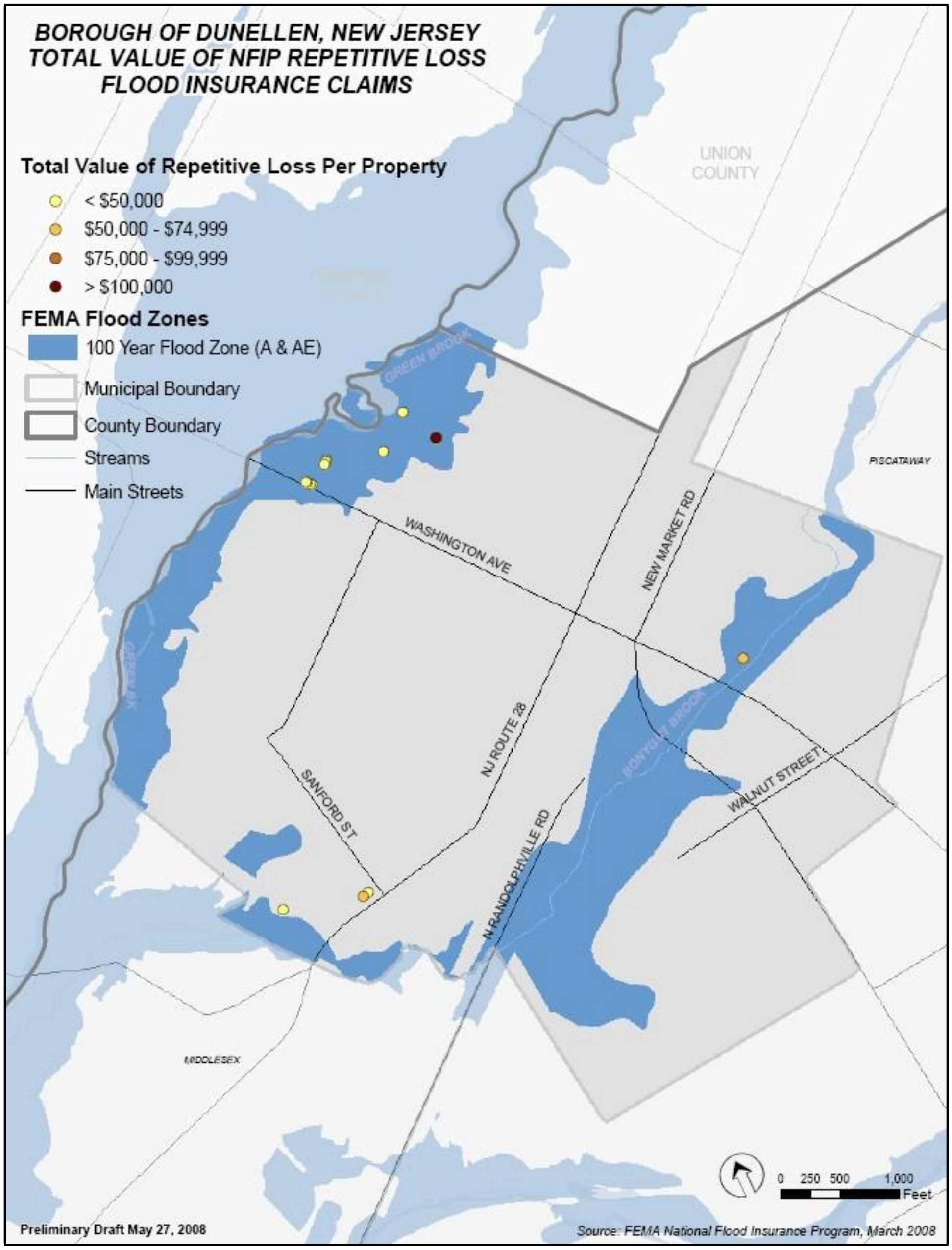
Figure 7.3.1-4
Value of NFIP Repetitive Loss Flood Insurance
Claims for South Plainfield Borough, New Jersey
(Source: FEMA Q3 Floodplain Data per NJDEP, and FEMA NFIP Query March 2008)



Note:
One of the 18 repetitive loss property addresses in South Plainfield was unable to be mapped, and therefore excluded.

The following map highlights the total value per property of NFIP repetitive loss flood insurance claims in Dunellen Borough, New Jersey.

Figure 7.3.1-5
Value of NFIP Repetitive Loss Flood Insurance
Claims for Dunellen Borough, New Jersey
(Source: FEMA Q3 Floodplain Data per NJDEP, and FEMA NFIP Query March 2008)



(1) One of the 17 repetitive loss property addresses in Dunellen Borough was unable to be mapped, and therefore excluded.

In the past few years the County has taken prior action to mitigate seven residential repetitive loss properties located along Raritan Avenue in Middlesex Borough. Table 7.3.1-7 summarizes the NFIP claims history for the seven mitigated properties.

Table 7.3.1-7:
Mitigated Repetitive Loss Properties in Middlesex County
(Source: FEMA NFIP query March, 2008)

Street Address	Municipality Name	NFIP Paid Claims	Cumulative NFIP Claims Paid	Mitigation Type
Raritan Avenue	Middlesex Borough	2	$79,215	Acquisition
Raritan Avenue	Middlesex Borough	2	$78,397	Acquisition
Raritan Avenue	Middlesex Borough	2	$59,800	Acquisition
Raritan Avenue	Middlesex Borough	2	$68,215	Acquisition
Raritan Avenue	Middlesex Borough	3	$46,576	Acquisition
Raritan Avenue	Middlesex Borough	2	$86,985	Acquisition
Raritan Avenue	Middlesex Borough	2	$62,528	Acquisition
Total	**---------------**	**15**	**$481,715**	

Flood Risk to Residential Properties

Residential flood risk is calculated by a simple methodology that uses the FEMA default present-value coefficients from the benefit-cost analysis software modules. To perform this calculation, the repetitive loss data was reviewed to determine an approximate period over which the claims occurred. There is not an exact method of doing this, because there are numerous properties in the database, and insurance policies come into force at different times, and are cancelled and reinstated periodically; these variables are not part of the query output. With the exception of a few claims in the 1970s and 1980s, almost all of the claims in the most recent NFIP query occurred between the early 1990s and the present, a period of about 15 years.

As shown in Table 7.3.1-8, there have been 465 claims in this 15-year period, for an average number of claims per year of 31. Based on a 100-year horizon and a present value coefficient of 14.27 (the coefficient for a 100-year planning horizon using the mandatory OMB discount rate of 7%), the projected flood risk to these properties is shown at the bottom of the table. It must be understood that individuals can obtain and cancel flood insurance policies, and the flood hazard depends on many variables, including the weather, so this projection is simply an estimate of potential damages. Nevertheless, it offers a useful metric that can be used in assessing the potential cost effectiveness of mitigation actions.

Table 7.3.1-8:
Projected 100-year Flood Risk in Middlesex County Repetitive Loss Areas
(Source: FEMA NFIP query March, 2008)

Data	Value
Period in years	15
Number of claims	465
Average claims per year	31
Total value of claims	$8,155,069
Average value of claims per year	$543,671
Projected risk, 100-year horizon	$7,758,185

The next table (7.3.1-9) shows risk projections for the three streets that appear to have the most risk in the County, based on NFIP repetitive loss records. These projections are done in the same manner as the calculation described above. Note that the projected 100-year risk per policy for all three streets is very similar. This risk figure is a good basis for determining the total amount that can be spent (either overall, or per typical property) on mitigation actions, although the ultimate cost effectiveness is also a function of the effectiveness and useful life of the project itself.

Table 7.3.1-9:
Projected 100-year Flood Risk, Select Streets in Middlesex County with Highest Number of Repetitive Flood Loss Claims in NFIP Database
(Source: FEMA NFIP Query March, 2008)

7th Street	
Total claims	23
Average claims per year	1.53
Total value of claims	$444,146
Average value of claims per year	$29,610
Projected risk, 100-year horizon	$435,860
Number of claimants	8
Projected risk per policy, 100-year horizon	$54,483
2nd Street	
Total claims	22
Average claims per year	1.46
Total value of claims	$168,861
Average value of claims per year	$11,257
Projected risk, 100-year horizon	$160,637
Number of claimants	9
Projected risk per policy, 100-year horizon	$17,849
Raritan Avenue	
Total claims	20
Average claims per year	1.3
Total value of claims	$709,840
Average value of claims per year	$47,323
Projected risk, 100-year horizon	$675,299
Number of claimants	9
Projected risk per policy, 100-year horizon	$75,033

Flood Risk to Non-Residential Properties

As noted in the section above, there is not sufficient flood insurance claims history for non-residential properties to allow a risk estimate based on this methodology. For one or two of the properties, it may be advisable to perform a more detailed, engineering data-based analysis to determine flood risk.

Severe Repetitive Loss Properties

In 2004 FEMA began to develop the Severe Repetitive Loss (SRL) Grant Program in an effort to reduce or eliminate flood damages to residential properties that met certain minimum requirements. The Agency initiated the program early in 2008. An SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building

Middlesex County has six properties on the SRL list. All six properties are in different municipalities within Middlesex County.

Table 7.3.1-10 provides loss estimates for SRL properties at the level of individual streets, as calculated by FEMA and the National Flood Insurance Program (Note that there is one SRL property on each street.). As part of its initiation of the SRL grant program, FEMA provided States with actuarial calculations of risk (maximum benefits of mitigation) for 30- and 100-year planning horizons. The data provided by FEMA includes more details about claims histories at the policy level, but that information is not included here because of data confidentiality limitations. The information can be obtained from Middlesex County on a need-to-know basis.

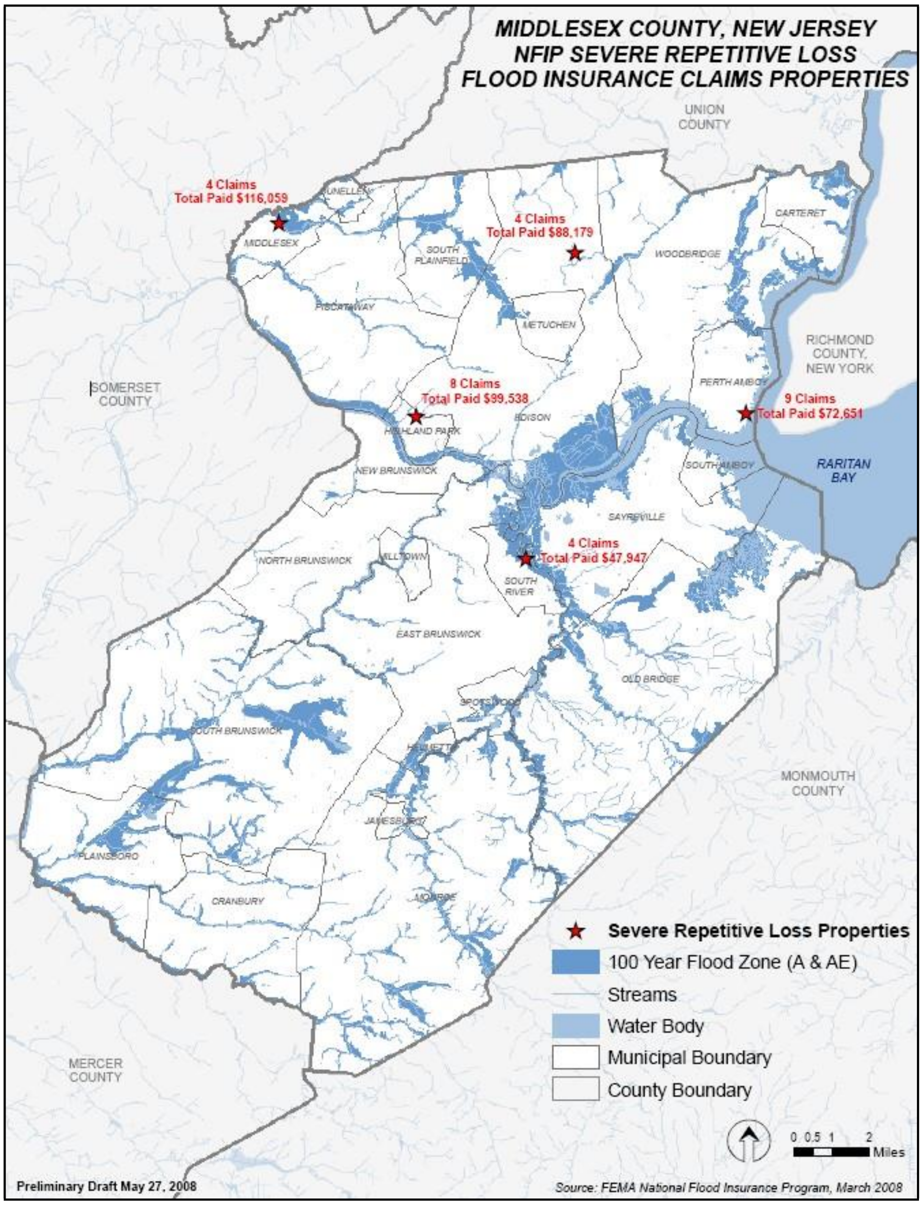
The columns labeled "30-year Risk" and "100-year Risk" show the expected future losses over those planning horizons, for each street in Middlesex County that includes an SRL property. As noted, the FEMA/NFIP calculations include these figures on the level of individual addresses and policies. It should be noted that the FEMA methodology does not express a complete range of potential risk (and benefits if the data is used in a BCA for a mitigation project), so individual properties should not be dropped from consideration for mitigation based solely on this calculation. More extensive risk assessment and benefit-cost analysis would include additional loss calculations that would likely increase the apparent risk, and concomitant benefits of reducing or eliminating it.

Table 7.3.1-10:
FEMA NFIP Actuarial Calculation of Potential Maximum Benefits
for Mitigating SRL Properties, ordered alphabetically by Municipality Name
(Source: FEMA/NFIP, Query March 2008)

Municipality Name		Paid		30-year	
Edison, Township of	Fishel Road	4	$88,179	$57,903	$66,584
Highland Park, Borough of	Harrison Avenue	8	$99,538	$43,180	$49,654
Middlesex, Borough of	Marshall Place	4	$116,059	$61,506	$70,727
Perth Amboy, City of	Water Street	9	$72,651	$52,945	$60,882
South River, Borough of	Causeway Street	4	$47,947	$47,344	$54,441
Woodbridge, Township of	Edgarton Boulevard	4	$56,864	$47,029	$54,079
Total	**----------------**	**33**	**$481,237**	**$309,908**	**$356,366**

The following map highlights the dollar amount and number of NFIP severe repetitive loss flood insurance claims in Middlesex County. Note that the property address on Edgarton Boulevard in Woodbridge Township could not be mapped and is therefore not shown.

Figure 7.3.1-6
NFIP Severe Repetitive Loss Flood Insurance Claims for Middlesex County
(Source: FEMA Q3 Floodplain Data per NJDEP, and FEMA NFIP Query March 2008)



(1) One of the six severe repetitive loss property addresses was unable to be mapped, and therefore excluded.

Flood Risk to Middlesex County Public Assets

Detailed engineering assessments are required to accurately calculate flood risk to public facilities. Without engineering study, the best source of vulnerability and risk data about public facilities is from insurance records or FEMA Public Assistance (PA) program Project Worksheets (PWs). After Presidentially-declared disasters, FEMA engineers visit communities to determine the nature and dollar amount of damages, so that federal funds can be provided to the community.

In the past ten years Middlesex County has experienced two Federally Declared disasters. The events occurred in September 1999 and April 2007. From April 14th to the 20th, 2007 most of the State of New Jersey was impacted by the effects of severe storms and coastal and inland flooding. The strong spring storm, know as a “Northeaster”, impacted the East Coast from South Carolina to Maine. On April 26, 2007, a Presidentially-declared Disaster was declared for 15 Counties in New Jersey (FEMA DR-1694).

Hurricane Floyd initially made landfall on September 16, 1999 along eastern North Carolina near Cape Fear as a Category 2 storm. As it continued in a northeast direction along the Eastern U.S. coastline Hurricane Floyd weakened to a tropical depression near the mid-Atlantic area. The tropical depression produced extreme rainfall totals of between 10-14 inches in some parts of New Jersey. After the event, portions of ten States from Florida to Connecticut received Presidential Disaster Declarations. On September 18, 1999 a Presidential Disaster was declared for twelve counties in central and northern New Jersey (FEMA DR-1295). The flash flooding and overbank riverine flooding from Hurricane Floyd caused a total of 57 deaths, six of which were in New Jersey. The FEMA Project Worksheets estimated the infrastructure damages in New Jersey from Hurricane Floyd at slightly over $53 million. Of this total, just over $2.4 million was allocated to Middlesex County. Table 7.3.1-11 summarizes the two disasters.

Table 7.3.1-11:
Summary of Presidentially-declared Disasters in Middlesex County
(Source: FEMA.gov)

Disaster #	Disaster Date	# Counties Affected	Type of Disaster
DR-1694	4/26/2007	15	Severe storms and Flooding
DR-1295	09/18/1999	12	Hurricane Floyd

Table 7.3.1-12 summarizes the Public Assistance provided for each of the declared disasters broken down by PA category (see descriptions below the table).

Table 7.3.1-12:
Project Worksheet Summary for DR-1694 and DR-1530,
by FEMA Public Assistance Program Category, Middlesex County
(Source: FEMA Region II, September 2007)

Disaster #	Cat. A	Cat. B	Cat. C	Cat. D	Cat. E	Cat. F	Cat. G	Total
DR-1694	$250,747	$603,069	$126,580	$112,312	$166,308	$115,404	$1,057,180	$2,431,600
DR-1295	$463,115	$895,400	$97,175	$41,359	$50,322	$52,100	$779,759	$2,379,231
Total	**$713,862**	**$1,498,469**	**$223,755**	**$153,671**	**$216,630**	**$167,504**	**$1,836,939**	**$4,810,831**

The FEMA Public Assistance categories are generally defined as follows:

- Category A: Emergency work, primarily debris clearance.
- Category B: Emergency protective measures.
- Category C: Permanent repair work, roads and bridges.
- Category D: Permanent repair work, water control facilities.
- Category E: Permanent repair work, public buildings.
- Category F: Permanent repair work, utilities.
- Category G: Permanent repair work, parks and recreation facilities.

Table 7.3.1-13 shows the amounts for each applicant that applied for Public Assistance in Middlesex County, broken down by PA category for disasters DR-1694 and DR-1295.

Table 7.3.1-13:
Project Worksheet Summary for All Middlesex County Applicants (DR-1694 and 1295), by FEMA Public Assistance Program Category, ordered by Total Assistance
(Source: FEMA Region II, September 2007)

Applicant Name	Cat. A	Cat. B	Cat. C	Cat. D	Cat. E	Cat. F	Cat. G	TOTAL
Middlesex (County)	$163,682	$138,330	$6,717	$0	$16,545	$22,637	$968,165	$1,316,075
New Brunswick	$25,883	$183,192	$40,000	$1,000	$0	$0	$508,436	$758,511
Edison (Township of)	$0	$227,659	$0	$95,714	$0	$90,015	$0	$413,388
Woodbridge (Township of)	$108,019	$92,312	$0	$0	$5,708	$0	$39,468	$245,507
Dunellen	$34,817	$52,238	$57,175	$4,296	$6,056	$52,100	$27,855	$234,537
Piscataway	$51,036	$150,053	$2,034	$2,000	$8,647	$0	$16,924	$230,694
Perth Amboy	$0	$40,986	$0	$0	$125,850	$1,752	$21,962	$190,550
North Brunswick (Township of)	$16,510	$57,401	$0	$37,063	$3,181	$0	$65,631	$179,786
South Brunswick (Township of)	$6,885	$78,474	$42,713	$0	$0	$0	$29,945	$158,017
South Plainfield	$78,018	$78,463	$0	$0	$1,250	$0	$0	$157,731
Middlesex Borough	$69,281	$21,674	$0	$15,598	$0	$0	$12,818	$119,371
Old Bridge (Township of)	$16,310	$92,245	$0	$0	$0	$0	$2,363	$110,918
Middlesex County Dept of Highways	$57,728	$18,535	$0	$0	$0	$0	$24,844	$101,107
Middlesex County Parks Dept	$12,170	$0	$0	$0	$0	$0	$75,264	$87,434
Sayreville	$7,392	$15,005	$31,243	$0	$0	$0	$25,482	$79,122
Metuchen	$27,569	$39,947	$0	$0	$1,000	$0	$0	$68,516
Cranbury (Township of)	$0	$17,077	$43,873	$0	$0	$0	$0	$60,950
Monroe (Township of)	$10,997	$49,720	$0	$0	$0	$0	$0	$60,717
Milltown	$8,287	$31,845	$0	$0	$14,955	$1,000	$0	$56,087
East Brunswick (Township of)	$0	$37,952	$0	$0	$0	$0	$0	$37,952
Middlesex Utilities Authority	$0	$0	$0	$0	$28,438	$0	$0	$28,438
Carteret	$2,962	$18,232	$0	$0	$1,000	$0	$2,390	$24,583
South River	$7,333	$10,559	$0	$0	$1,000	$0	$4,555	$23,447
Piscataway Township Public Schools	$0	$21,175	$0	$0	$0	$0	$0	$21,175

Applicant Name	Cat. A	Cat. B	Cat. C	Cat. D	Cat. E	Cat. F	Cat. G	TOTAL
Highland Park Middlesex	$4,488	$11,572	$0	$0	$0	$0	$0	$16,060
Board of Education	$2,897	$0	$0	$0	$0	$0	$10,837	$13,734
Plainsboro (Township of)	$0	$9,844	$0	$0	$0	$0	$0	$9,844
Helmetta Spotswood	$0	$6,028	$0	$0	$0	$0	$0	$6,028
Middlesex Borough Rescue Squad	$0	$4,646	$0	$0	$0	$0	$0	$4,646
Middlesex County Sherriff's Department	$0	$2,761	$0	$0	$0	$0	$0	$2,761
Jamesburg	$0	$2,601	$0	$0	$0	$0	$0	$2,601
Carteret Volunteer First Aid Squad Inc.	$1,598	$0	$0	$0	$0	$0	$0	$1,598
Grand Total	$0	$0	$0	$0	$1,000	$0	$0	$1,000
	$713,862	**$1,510,525**	**$223,755**	**$155,671**	**$214,630**	**$167,504**	**$1,836,939**	**$4,822,887**

The data in Table 7.3.1-13 identifies that the applicant Middlesex County has received the most FEMA Public Assistance funds in the County over the last ten years. The County received a combined total of just over $1.3 million in PA funds from Tropical Storm Floyd and the April 2007 flood. Of this total, roughly $968,000 was related to repairs to parks and recreational facilities. The City of New Brunswick received the second highest amount of assistance over this time period, with approximately $758,000 in assistance.

The table also shows that for FEMA categories C - G (permanent work), the highest estimated damages were related to Category G, park and recreational facilities. For all applicants in Middlesex County, this category totaled slightly more than $1.8 million, or about 38% of the grand total. This analysis uses previous flood damages, as shown by PWs from two previous disasters, to indicate a rough dollar value of assets at risk by PA category. As mentioned above, without a detailed engineering study the PW records offer the best source of vulnerability and risk data about public facilities.

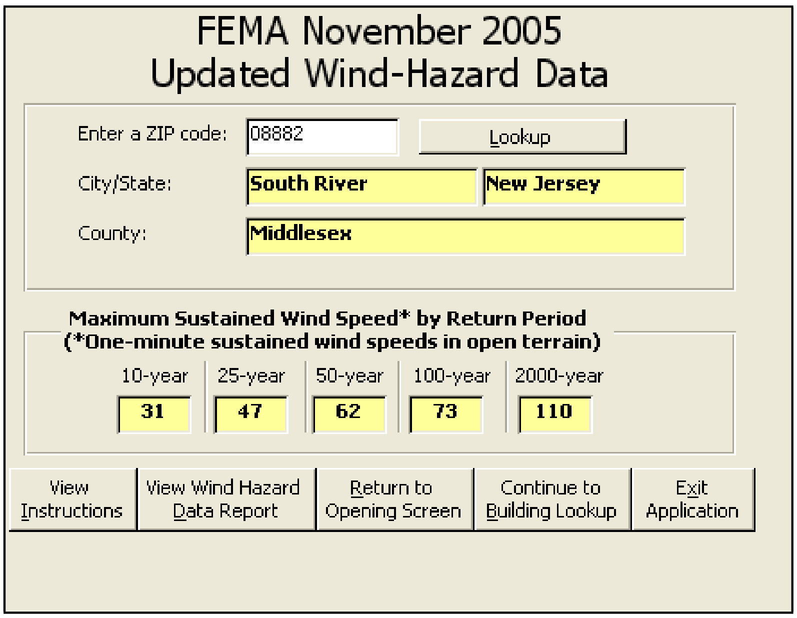
Table 7.3.1-13 is a summary of a more detailed FEMA database of Project Worksheets, which includes specific information about the location and nature of damages, based on post-event FEMA inspections. The summary data can be used by the County as one means of identifying general vulnerabilities, by examining categories of damages, where damages have occurred, or which applicants appear to have the most vulnerability. In New Jersey, the FEMA PW data is not as rich a source of information as it would be in other States that experience more disasters, but it nevertheless offers an additional perspective on damages to public facilities, particular if the more detailed information is reviewed. It should be understood that damages alone are not a strong indicator of vulnerabilities, because in many cases facilities that were damaged in prior events have been replaced with stronger facilities, or themselves hardened to better resist hazards.

7.3.2 Wind Risk in Middlesex County

This subsection describes the risk assessment for hurricane winds in Middlesex County. The calculations are done using the FEMA Full Data Hurricane Wind Benefit-Cost Analysis (BCA) module. Data about various asset classes were extracted from the FEMA HAZUS database in Fall, 2007.

The first step in the risk assessment process is to determine wind profiles for the county, using the FEMA wind hazard and damage function database (BCA Toolkit). Figure 7.3.2-1 shows the wind hazard profiles for Middlesex at ZIP code 08882. This ZIP code (for the South River School District central facility) was used because it is near the central geographic point in the county. There is very little wind speed differential across the county, so these figures can be considered reasonably accurate for all of Middlesex County.

Figure 7.3.2-1
Middlesex County Wind Hazard Profiles
(Source: FEMA wind hazard database (BCA Toolkit))



The wind risk assessment for the county was then conducted using the FEMA Hurricane Wind BCA software and the FEMA wind database on the BCA Toolkit Version 3.0. All figures are based on 100-year time horizon and a 7% discount rate to determine net present value of the risk. Table 7.3.2-1 shows the expected annual number of hurricane wind storms in Middlesex County by class.

Table 7.3.2-1:
Expected Annual Number of Wind Storms by Class, Middlesex County
(Source: FEMA Full-Data Hurricane Wind BCA module)

EXPECTED ANNUAL NUMBER OF WIND STORMS			
Storm Class	Wind Speed (mph)	Default Estimate	User Estimate
0	60-73	1.266E-02	
1	74-95	7.702E-03	
2	96-110	8.838E-04	
3	111-130	3.285E-04	
4	131-155	9.869E-05	
5	>155	4.081E-05	

Note: User Estimate column is intentionally left blank. This column can be used to override the default estimates calculated by the module.

Estimated Hurricane Wind Risk to Public and Private Assets

Damage functions for all structure types are verbatim from the FEMA software; the FEMA/HAZUS structure and roof types used in the analysis are noted in Table 7.3.2-2. Note that these assumptions are intended only to provide a general estimate of potential wind risk. Specific mitigation projects will require more detailed engineering assessments. The major roadways, transportation, communications and utilities classes were not assessed as part of this plan because most of these are unique and require detailed engineering studies to be accurate.

Table 7.3.2-2:
Abbreviations for HAZUS Structure Types
(Source: HAZUS)

HAZUS Structure Type	Roof Type	Abbreviation
Wood framed non-engineered gable	Gable	WMUH1 #1
Steel frame engineered commercial	Flat	SECBL #28
Masonry Industrial - RM	Flat	MLRI #25
Pre-Engineered Metal Building	Flat	SPMBL #42
Masonry non-engineered reinforced gable	Gable	MERBL #13
Concrete engineered commercial	Flat	CECBL #35
Masonry non-engineering reinforced hip	Hip	MERBL #14

A query from HAZUS version MR1 (v.1.1) in the fall of 2007 was used as the basis for total structure and content values for each land use category for Middlesex County. The HAZUS query results include only the estimated dollar value for each category and not the total square footage. The results for Middlesex County are shown in Table 7.3.2-3. Following this table is a description of how the square footage estimates were calculated.

Table 7.3.2-3:
Middlesex County: Square Footage and Value for Predominant Asset Classes
(Source: HAZUS version MR1 (v.1.1), Fall 2007)

Land Use Category	HAZUS Building Type	Total Square Footage	Structure Value (HAZUS)	Contents Value (HAZUS)
Residential	WMUH1	300,716,000	$37,589,480,000	$18,802,507,000
Commercial	SECBL	50,293,000	$7,644,580,000	$7,933,962,000
Industrial	MLRI	18,924,000	$2,308,702,000	$3,346,046,000
Agriculture	SPMBL	1,736,000	$80,040,000	$80,040,000
Education	MERBL	481,000	$293,432,000	$317,443,000
Government	CECBL	1,456,000	$80,798,000	$90,957,000
Religious	MERBL	870,000	$298,445,000	$298,445,000
Total	**--------**	**374,476,000**	**$48,295,477**,000	**$30,869,400**,000

The online RS Means Quickcost Estimator was used to estimate the dollar per square foot cost for each land use category. The ZIP code 08882 for the South River School District's central facility was again used because of its central location in the county. For each asset, estimates were made about the average building square footage and a typical facility type for each land use category. Table 7.3.2-4 summarizes the assumptions and results for each land use category, with the exception of residential which was estimated $125 per square foot.

Table 7.3.2-4:
Middlesex County: Predominant Asset Classes
Assumptions and Results of RS Means Quickcost Estimator

Land Use Category	Average Building SF	Building Type	$ Per SF Cost	Basis Construction Type	Construction Cost
Commercial	35,000	Office 2-4 Story	$152	Face Brick with Concrete Block Back Up/ Wood Joist	$5,331,341
Industrial	75,000	Factory (3 Story)	$122	Face Brick, Common Brick backup / Steel Frame	$9,129,237
Agriculture	25,000	Warehouse (Representing Barn/storage)	$92	Tilt-up Concrete Panels/Steel Frame	$2,297,619
Education	50,000	Jr. High School	$169	Face Brick with Concrete Block Back Up/ Steel Frame	$8,432,949
Government	30,000	Police Station	$168	Limestone with Concrete Block Backup	$5,040,535
Religious	5,000	Church	$205	Decorative Conc Block / Wood Arch	$1,027,033

The output from the Quickcost Estimator includes construction low, medium, and high cost ranges. The medium construction cost was used in the present analysis. Figure 7.3.2-2 provides a sample of the R.S. Means output for the education category, a 2-3 story Jr. High School. Note that although the ZIP code for South River was entered as the project location, the estimating tool changed the location to New Brunswick.

This is most likely a result of New Brunswick being the closest city included in the Quickcost Estimator database.

Figure 7.3.2-2
RS Means Quickcost Estimator
Education Asset Class Results

RSMeans QuickCost Estimator

Project Title:	{Not Provided}
Model:	School, Jr High, 2-3 Story
Construction:	Face Brick with Concrete Block Back-up / Steel Frame
Location:	NEW BRUNSWICK, NJ
Stories:	2
Story Height (l.f.):	15
Floor Area (s.f.):	50,000
Data Release:	2008
Wage Rate:	Union
Basement:	Not included

Costs are derived from a building model with basic components. Scope differences and market conditions can cause costs to vary significantly.

Cost Ranges	Low	Med	High
Total:	$5,754,600	$6,394,000	$7,992,500
Contractor's Overhead & Profit:	$1,438,650	$1,598,500	$1,998,125
Architectural Fees:	$396,404	$440,449	$550,562
Total Building Cost:	**$7,589,654**	**$8,432,949**	**$10,541,187**

Wind risk for Middlesex County assets is then calculated using the FEMA Full-Data Hurricane Wind BCA module and the wind damage functions in the FEMA wind hazard database (BCA Toolkit). The assessment uses a 100-year time horizon. Data parameters used in the Wind BCA Module as part of the risk assessment are described in Table 7.3.2-5.

Table 7.3.2-5:
Data Parameters Entered into BC Module for each Asset Class

Data Field	Values per Category
Rental Cost of Temporary Building Space	▪ Government: $1 per SF/Month ▪ Agriculture: $1 per SF/Month ▪ Education: $1 per SF/Month ▪ Commercial: $1 per SF/Month ▪ Industrial: $2 per SF/Month ▪ Religious: $1 per SF/Month ▪ Residential: $1 per SF/Month
Other Costs of Displacement	▪ Government: $481,000 per month ▪ Agriculture: $870,000 per month ▪ Education: $1,736,000 per month ▪ Commercial: $50,293,000 per month ▪ Industrial: $37,848,000 per month ▪ Religious: $1,456,000 per month ▪ Residential: $300,716,000 per month
One Time Displacement cost	▪ Government: Equal to Building SF ▪ Agriculture: Equal to Building SF ▪ Education: Twice the building SF ▪ Commercial: Equal to Building SF ▪ Industrial: Twice the building SF ▪ Religious: Equal to Building SF ▪ Residential: Equal to Building SF
Annual Budget	▪ Education: $150 per SF ▪ Government: $200 per SF ▪ Remaining Categories: $0
Estimated Net Income of Commercial Business	▪ Commercial: $100 per SF ▪ Industrial: $200 per SF ▪ Agriculture: $25 per SF ▪ Remaining Categories: $0

The data parameters described above are then used in the FEMA Hurricane Wind BCA module to calculate hurricane wind risk for Middlesex County. Tables 7.3.2-6 and 7.3.2-7 summarize the results of the analysis. The last column *100-year Wind Risk* indicates the estimated cumulative wind damages over a 100-year planning horizon, using the mandated 7% discount rate for net present value.

In Table 7.3.2-6, the data is sorted by 100-year risk. This table shows the wind risk by building category and the total wind risk for Middlesex County assets from hurricanes. Although these figures seem relatively high, it should be noted that this hazard (hurricane wind) affects all the assets in Middlesex County about equally, whereas flooding generally affects only those assets or operations that are close to flood sources. The last column *100-year Wind Risk* indicates the cumulative expected wind damages over a 100-year planning horizon, using the mandated 7% discount rate for net present value. Table 7.3.2-7 sorts the data by risk per square foot. When sorted by risk per square foot the government and commercial categories move to the top of the list.

Table 7.3.2-6:
Estimated Hurricane Wind Risk to Middlesex County Assets, ordered by 100-year Risk
(Sources: HAZUS Query, Fall 2007, FEMA Hurricane Wind BCA Module)

Land Use Category	HAZUS Structure Type	Total SF	Risk per SF	Annual Building Damages	Annual Content Damages	Annual Displacement Costs	Business Income Lost	Annual Public Services Lost	Total Annual Damages	100-yr Risk
Residential	WMUH1	300,716,000	$0.94	$14,032,279	$2,915,956	$6,820,765	$0	$175,034	$23,944,035	$341,681,379
Commercial	SECBL	50,293,000	$4.41	$7,154,806	$5,969,287	$2,822,836	$738,728	$77,524	$16,763,181	$239,210,593
Industrial	MLRI	18,924,000	$1.27	$2,008,434	$1,578,298	$1,793,536	$570,164	$24,012	$5,974,445	$85,255,330
Education	MERBL	1,736,000	$1.80	$107,075	$82,117	$55,601	$0	$18,552	$263,345	$3,757,933
Government	CECBL	481,000	$4.85	$78,304	$68,433	$27,792	$0	$15,186	$189,716	$2,707,247
Religious	MERBL	1,456,000	$1.32	$84,014	$49,090	$27,464	$0	$1,052	$161,620	$2,306,317
Agriculture	SPMBL	870,000	$0.51	$67,040	$48,636	$28,254	$3,081	$783	$147,794	$2,109,020
Total	---------	**374,476,000**	-------	**$23,531,952**	**$10,711,817**	**$11,576,248**	**$1,311,973**	**$312,143**	**$47,444,136**	**$677,027,821**

Table 7.3.2-7:
Estimated Hurricane Wind Risk to Middlesex County Assets, ordered by Risk per Square Foot
(Sources: HAZUS Query, Fall 2007, FEMA Hurricane Wind BCA Module)

Land Use Category	HAZUS Structure Type	Total SF	Risk per SF	Annual Building Damages	Annual Content Damages	Annual Displacement Costs	Business Income Lost	Annual Public Services Lost	Total Annual Damages	100-yr Risk
Government	CECBL	481,000	$5.63	$78,304	$68,433	$27,792	$0	$15,186	$189,716	$2,707,247
Commercial	SECBL	50,293,000	$4.76	$7,154,806	$5,969,287	$2,822,836	$738,728	$77,524	$16,763,181	$239,210,593
Industrial	MLRI	18,924,000	$4.51	$2,008,434	$1,578,298	$1,793,536	$570,164	$24,012	$5,974,445	$85,255,330
Agriculture	SPMBL	870,000	$2.42	$67,040	$48,636	$28,254	$3,081	$783	$147,794	$2,109,020
Education	MERBL	1,736,000	$2.16	$107,075	$82,117	$55,601	$0	$18,552	$263,345	$3,757,933
Religious	MERBL	1,456,000	$1.58	$84,014	$49,090	$27,464	$0	$1,052	$161,620	$2,306,317
Residential	WMUH1	300,716,000	$1.14	$14,032,279	$2,915,956	$6,820,765	$0	$175,034	$23,944,035	$341,681,379
Total		**374,476,000**		**$23,531,952**	**$10,711,817**	**$11,576,248**	**$1,311,973**	**$312,143**	**$47,444,136**	**$677,027,821**

Figure 7.3.2-3 is a sample of the results for the Education category from the Hurricane Wind Module. The summary of expected annual damages and benefits for each category was used to populate Tables 7.3.2-6 and 7.3.2-7 above.

Figure 7.3.2-3
Hurricane Wind Benefit Cost Module
Education Asset Class: Summary of Expected Annual Damages and Benefits
(Source: FEMA Hurricane Wind BCA Module)

BENEFIT-COST RESULTS

Hurricane Wind Risk Assessme	Education	MERBL #13	
Building Type Selected	Other		
Project Description			
Discount Rate	7.00%	Project Useful Life (years)	100
Present Value Coefficient	14.27		

SUMMARY OF EXPECTED ANNUAL DAMAGES AND BENEFITS

	Expected Annual Damages Before Mitigation	Expected Annual Damages After Mitigation	Expected Annual Benefits	Present Value of Annual Benefits
Building Damages	$107,075	$0	$107,075	$1,527,880
Contents Damages	$82,117	$0	$82,117	$1,171,745
Displacement Costs	$55,601	$0	$55,601	$793,380
Business Income Lost	$0	$0	$0	$0
Rental Income Lost	$0	$0	$0	$0
Public Services Lost	$18,552	$0	$18,552	$264,725
Total Losses & Benefits	$263,345	$0	$263,345	$3,757,730

PROJECT BENEFITS	GRAPH	$3,757,730
PROJECT COSTS		$1
BENEFITS MINUS COSTS		$3,757,729
BENEFIT-COST RATIO		**3757729.58**

FEMA Disclaimer: The results produced by this analysis are neither conclusive evidence that the proposed project is cost-effective, nor a guarantee that a project is eligible for any government grant for whatever purpose.

Table 7.3.2-8 summarizes hurricane wind risk for the 25 municipalities within Middlesex County. The municipal-level calculation is done proportionally, using the value of local structural exposure compared to the County-level values. This proportion is then multiplied by the same values that are shown in Table 7.3.2-6 to estimate the local risk. It should be noted that these techniques produce risk figures that are very general, and should be used for the purpose of planning and prioritizing where additional study should be conducted.

Table 7.3.2-8:
Estimated Hurricane Wind Risk for Assets in the 25 Middlesex County Municipalities, ordered by Total 100-year Risk
(Sources: HAZUS Query, Fall 2007, FEMA Hurricane Wind BCA Module)

Municipality Name	Residential	Commercial	Industrial	Agricultural	Education	Government	Religious	Total Risk
Edison	$47,402,980	$49,822,309	$17,821,329	$92,645	$923,257	$250,091	$273,247	$116,585,858
Woodbridge	$42,501,361	$38,435,072	$7,618,689	$94,121	$303,611	$549,404	$196,208	$89,698,466
North Brunswick	$32,310,634	$19,380,721	$11,967,051	$97,256	$518,151	$364,281	$287,489	$64,925,584
East Brunswick	$24,217,328	$19,488,708	$3,514,531	$76,914	$301,819	$298,341	$183,164	$48,080,805
Piscataway	$23,250,708	$15,029,540	$7,035,082	$31,988	$697,754	$7,740	$94,449	$46,147,262
Old Bridge	$27,954,532	$11,097,259	$2,321,467	$136,754	$209,033	$34,981	$97,308	$41,851,334
South Brunswick	$18,715,163	$15,255,402	$6,784,490	$108,165	$67,108	$369,642	$129,757	$41,429,728
Perth Amboy	$15,021,845	$12,364,222	$2,007,212	$5,428	$63,099	$155,704	$251,191	$29,868,701
South Plainfield	$10,710,537	$10,669,629	$7,139,108	$87,402	$53,648	$42,285	$30,247	$28,732,854
Sayreville	$18,176,583	$6,500,752	$2,101,008	$7,958	$50,907	$133,322	$75,423	$27,045,953
Monroe	$16,890,147	$4,907,388	$3,263,090	$37,864	$103,902	$72,575	$55,478	$25,330,443
Plainsboro	$11,151,093	$7,595,080	$917,361	$9,591	$125,866	$72,206	$104,611	$19,975,807
Carteret	$8,014,616	$5,002,295	$2,979,890	$4,216	$29,827	$56,123	$22,805	$16,109,772
Middlesex	$6,205,716	$3,763,370	$2,728,781	$1,149,000	$10,143	$0	$16,051	$13,873,060
Metuchen	$7,023,436	$4,334,659	$550,520	$17,733	$82,796	$40,643	$70,338	$12,120,125
South River	$6,592,051	$2,953,576	$470,977	$13,280	$10,822	$19,233	$40,988	$10,100,927
Highland Park	$5,973,289	$2,831,946	$190,732	$9,776	$32,094	$0	$76,814	$9,114,651
Cranberry	$2,097,656	$3,442,569	$1,940,446	$63,687	$37,050	$6,065	$44,690	$7,632,163
Dunellen	$3,072,575	$1,037,815	$2,598,389	$5,797	$2,100	$66,845	$56,861	$6,840,383
Milltown	$3,602,511	$1,821,981	$196,899	$1,976	$49,460	$43,659	$41,691	$5,758,177
Spotswood	$3,499,560	$974,293	$637,891	$23,161	$40,495	$20,171	$33,763	$5,229,334
South Amboy	$3,430,396	$1,161,072	$218,280	$0	$0	$87,117	$14,876	$4,911,741
Jamesburg	$2,944,327	$1,233,105	$208,531	$18,787	$44,990	$16,820	$100,453	$4,567,015
Helmetta	$922,334	$107,831	$43,575	$15,520	$0	$0	$8,416	$1,097,675
Total	**$341,681,379**	**$239,210,593**	**$85,255,330**	**$2,109,020**	**$3,757,933**	**$2,707,247**	**$2,306,317**	**$677,027,819**

7.3.3 Severe Storm - Winter Weather Risk in Middlesex County

The National Oceanic Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC) database lists 94 winter storm/snow/ice events from 1994 to 2007 for Middlesex County. The web site does not indicate why the data does not extend to 1950. However, the amount of data that is presently on the site is sufficient for a basic risk assessment for Middlesex County. Table 7.3.3-1 shows the basic data required for the assessment; all information is from open sources.

Table 7.3.3-1:
Data Parameters for Middlesex Winter Storm Risk Assessment;
Data from the NOAA/NCDC Database (1995-2007)
(Source: NOAA/NCDC)

Data	Value
Winter storm events	94
Average annual number of winter storm events	7.23
Total reported damages	$19,000,000
Annual damages	$1,461,538
Reported deaths	1
Annual deaths	.076
Value of single death (FEMA, approximately 1998 value)	$3,000,000
Estimated annual cost of deaths from winter storms	$228,000
Reported injuries	39
Annual injuries	3
Value of single injury (FEMA, approximately 1998 value)	$20,000
Estimated annual cost of injuries from winter storms	$60,000

After determining the annual figures for damages, deaths and injuries for the County, the risk assessment comprises a simple projection of future expected damages based on a standard present value coefficient of 14.27. This represents a 100-year time horizon and a 7% discount rate (the latter required by OMB).

Table 7.3.3-2:
Estimate of Risk to Middlesex County from Winter Storms
(Source: NOAA/NCDC)

Data	Value
Annual damages to Middlesex County	$1,461,538
Projected risk from direct winter storm damages	$20,856,147
Estimated Annual cost of deaths	$228,000
Projected risk from winter storm-related deaths	$3,253,560
Estimated annual cost of injuries	$60,000
Projected risk from winter storm-related injuries	$856,200
Estimated total risk from winter storms (100-year horizon)	**$24,965,907**

The winter weather risk for Middlesex County can be further broken down from summarizing at the county level to focusing on individual municipalities. Specific municipality level winter weather data was not available for Middlesex County from the NCDC database or other sources. In the absence of this data, the winter weather damages for each municipality were calculated as a proportion of the Middlesex County population. In the year 2000, the US Census Bureau reported that the total population in Middlesex County was 1,500,504. For each municipality, the percentage of the county population was calculated. The total winter weather damages for each municipality were then calculated by multiplying the percent of the county population by $19,000,000, the total winter weather damages for the county.

Table 7.3.3-3 provides a summary of the winter weather risk for each of the 25 municipalities within Middlesex County. For each municipality, the annual damages were calculated by dividing the total damages by 13, the number of years reported in the NCDC database. The last column, *100-year Winter Weather Risk,* indicates the estimated cumulative wind damages over a 100-year planning horizon, using the mandated 7% discount rate for net present value. The table shows that Middlesex Borough has the highest 100-year winter weather risk.

Table 7.3.3-3:
Estimate of Risk to the 25 Middlesex County Municipalities from Winter Storms, ordered by 100-year risk
(Sources: NOAA/NCDC, US Census Bureau)

Municipality Name	Population	% of Co. Population	Total Damages	Annual Damages	100-year Risk
Middlesex	750,162	49.99%	$9,498,860	$730,682	10,426,826
Edison	97,687	6.51%	$1,236,953	$95,150	1,357,794
Woodbridge	97,203	6.48%	$1,230,824	$94,679	1,351,067
Old Bridge	60,456	4.03%	$765,519	$58,886	840,304
Piscataway	50,482	3.36%	$639,224	$49,171	701,671
New Brunswick	48,573	3.24%	$615,051	$47,312	675,137
Perth Amboy	47,303	3.15%	$598,970	$46,075	657,485
East Brunswick	46,756	3.12%	$592,044	$45,542	649,882
Sayreville	40,377	2.69%	$511,270	$39,328	561,217
South Brunswick	37,734	2.51%	$477,803	$36,754	524,481
North Brunswick	36,287	2.42%	$459,481	$35,345	504,369
Monroe	27,999	1.87%	$354,535	$27,272	389,170

Municipality Name	Population	% of Co. Population	Total Damages	Annual Damages	100-year Risk
South Plainfield	21,810	1.45%	$276,167	$21,244	303,147
South Amboy	21,810	1.45%	$276,167	$21,244	303,147
Carteret	20,709	1.38%	$262,226	$20,171	287,843
Plainsboro	20,215	1.35%	$255,971	$19,690	280,977
South River	15,322	1.02%	$194,013	$14,924	212,967
Highland Park	13,999	0.93%	$177,261	$13,635	194,578
Metuchen	12,840	0.86%	$162,585	$12,507	178,469
Spotswood	7,880	0.53%	$99,780	$7,675	109,528
Milltown	7,000	0.47%	$88,637	$6,818	97,296
Dunellen	6,823	0.45%	$86,396	$6,646	94,836
Jamesburg	6,025	0.40%	$76,291	$5,869	83,744
Cranberry	3,227	0.22%	$40,862	$3,143	44,853
Helmetta	1,825	0.12%	$23,109	$1,778	25,366
Total	**1,500,504**	**---------**	**$19,000,000**	**$1,461,538**	**20,856,154**

7.3.4 Earthquake Risk in Middlesex County

As noted in the Hazard Identification and Profiling section, earthquake risk in New Jersey is concentrated in the northern part of the state, including Middlesex County. The northeastern part of the US is not particularly seismic compared to other areas such as California and Alaska, earthquake risk in New Jersey can be considered moderate because of the extensively built up environment and population density. As part of an ongoing effort to estimate seismic risk in the state, the New Jersey Geologic Survey is using the FEMA HAZUS software to calculate seismic risk for counties in the northern part of the state, including Middlesex. The results of these calculations are described in detail in a paper entitled *Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component*[3].

As described on page 8 (et seq.) of the report, New Jersey Geologic Survey (NJGS) obtained soils, liquefaction susceptibility and landslide susceptibility data through research and field work, and incorporated it into the HAZUS model. Middlesex County seismic soil class map is shown in Figure 7.3.4-1, and soil liquefaction susceptibility map in Figure 7.3.4-2 below. In addition to the *Earthquake Loss Estimation Study for Middlesex County*, earthquake loss estimates for Middlesex County are summarized from the *HAZUS Multi-Hazard (MH) Estimated Annualized Earthquake Losses for the United States*.

[3] New Jersey Geologic Survey, 2003

Figure 7.3.4-1
Middlesex County, New Jersey Seismic Soil Class
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component (New Jersey Geologic Survey, 2003), page 122).

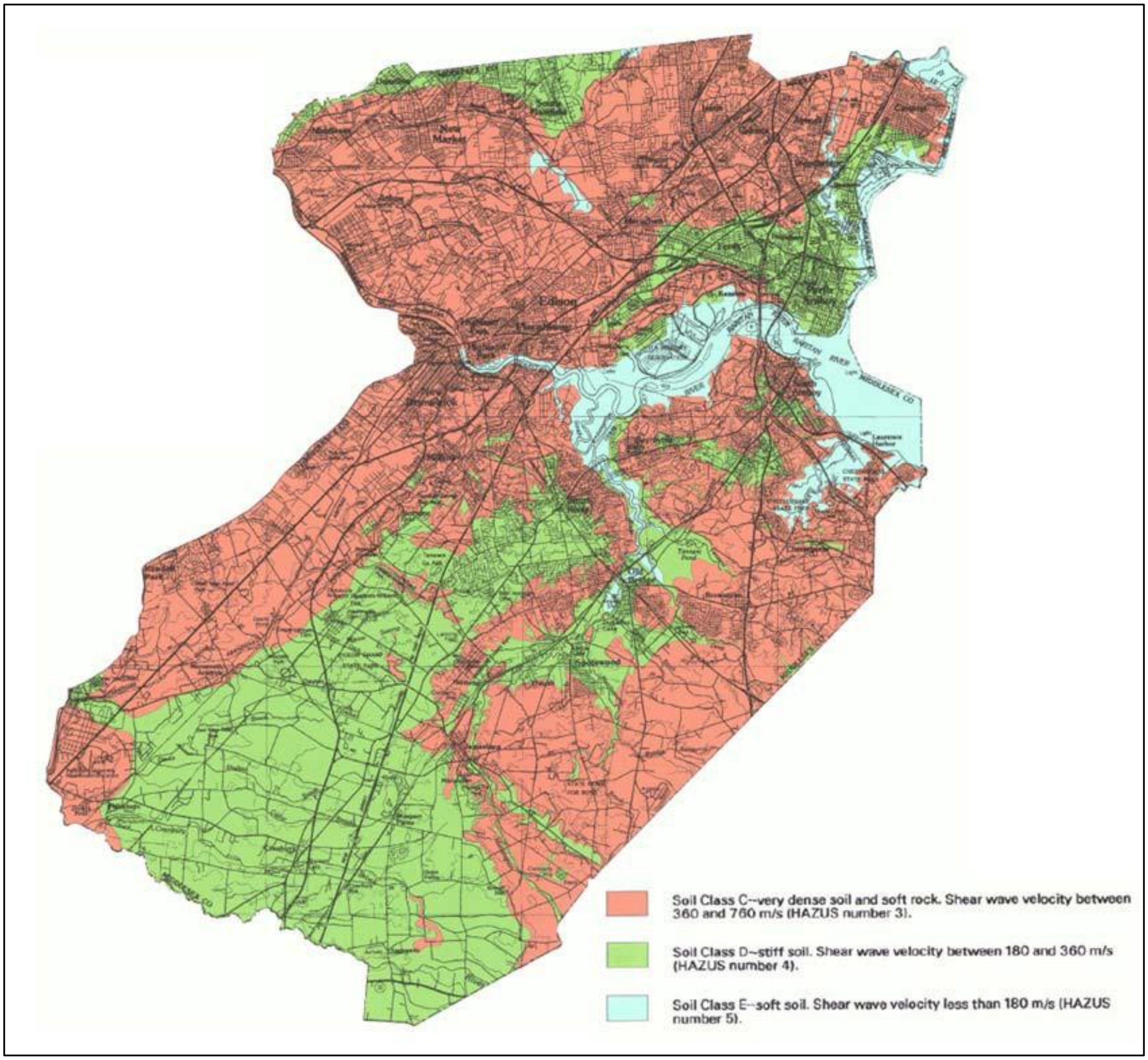
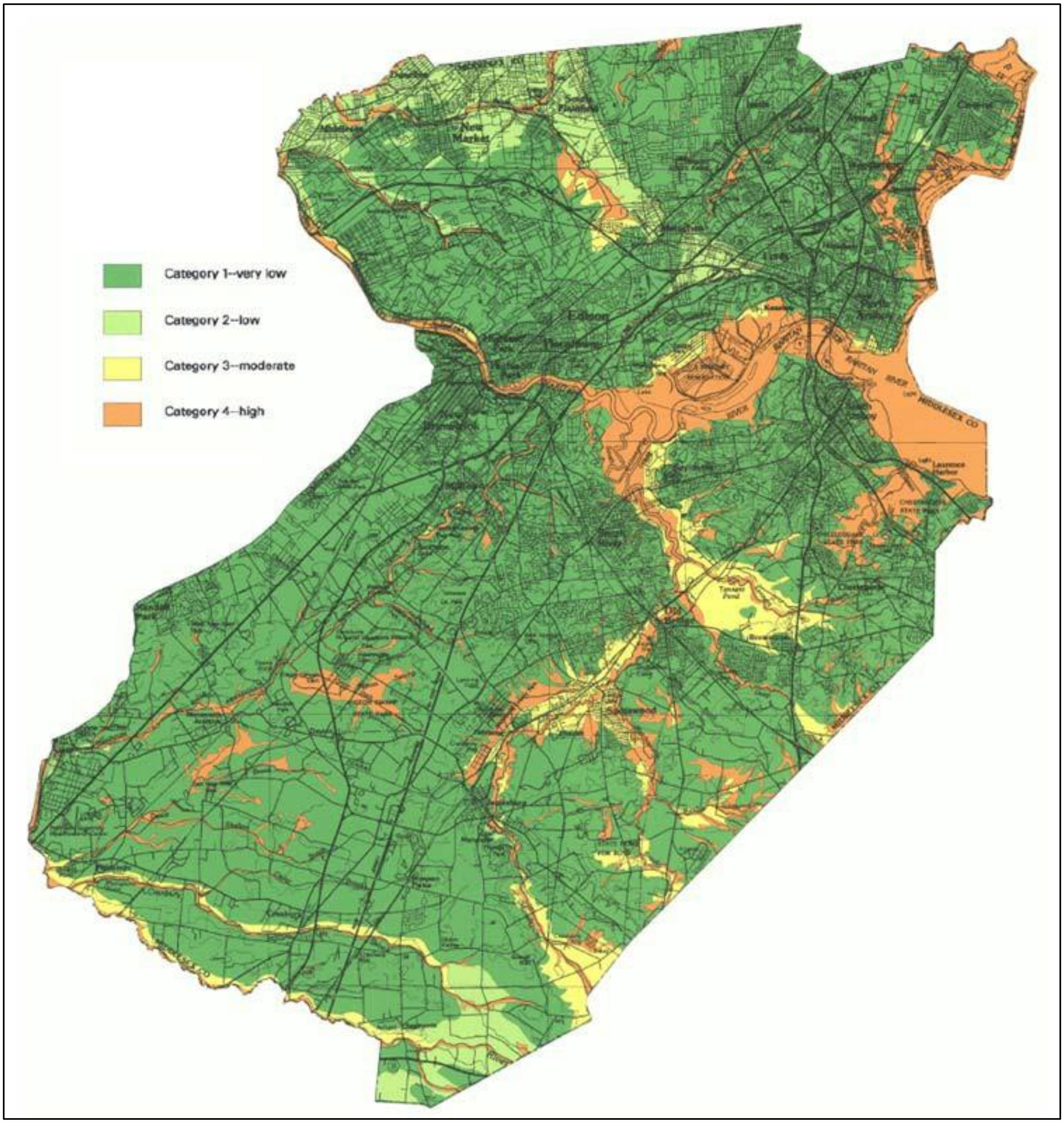


Figure 7.3.4-2
Middlesex County, New Jersey Soil Liquefaction Susceptibility
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component (New Jersey Geologic Survey, 2003), page 123).



The agency completed a total of 12 HAZUS-based simulations, with variations in default and upgraded geology (meaning with and without incorporating data from the field borings and tests), and in liquefaction vs. non-liquefaction. Simulations were based on a range of earthquake magnitudes (Richter 5.0, 5.5, 6.0, 6.5 and 7.0), with resulting deterministic (single scenario) results.

The results of these calculations are shown in Tables 7.3.4-1 through 7.3.4-4, and are discussed in text below. The following table displays the building, contents, and business interruption damages to Middlesex County assets (in billions of dollars) for Richter Magnitudes 5.0 through 7.0 with full upgrade geology. HAZUS does not include default data for utility system lifelines and therefore the infrastructure damages were not calculated for underground utilities.

Table 7.3.4-1:
Deterministic Earthquake Scenario Damages to Middlesex County Assets for Richter Magnitudes 5.0 through 7.0 (full upgrade geology); Range of Potential Monetary Values of Damages to Select Asset Classes (in $ billions)
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component, New Jersey Geologic Survey, 2003)

Damage Type	5.0	5.5	6.0	6.5	7.0
Building Damages	$0.3 - 1.0	$0.7 - 2.8	$1.6 - 6.50	$3.0 - 11.80	$4.5 - 18.20
Contents Damages	$0.2 -.70	$0.4 - 1.60	$0.8 - 3.0	$1.2 - 4.8	$1.7 - 6.60
Business Interruption	$0.0 - .10	$0.2 - .70	$.5 – 2.0	$0.9 – 3.7	$1.50 – 5.80
Infrastructure: Lifeline Damage	------	------	------	------	------

The following table displays the potential residential and commercial structures in Middlesex County with minor and major damages (in thousands of buildings) for Richter Magnitudes 5.0 through 7.0.

Table 7.3.4-2:
Deterministic Earthquake Scenario Damages to Middlesex County Assets for Richter Magnitudes 5.0 through 7.0 (full upgrade geology); Potential Numbers of Residential and Commercial Structures with Minor and major Damages (in thousands of buildings).
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component, New Jersey Geologic Survey, 2003)

Damage Type	5.0	5.5	6.0	6.5	7.0
Residential (minor)	5 - 20	20 - 100	40 - 160	50 - 200	50 -200
Residential (major)	0 - 1.0	1.0 - 5.0	5 - 19	11 - 40	19 - 80
Commercial (minor)	< 1.0	0 - 2.0	1 - 4.0	1.0 - 4	1.0 - 3.0
Commercial (major)	< 1.0	< 1.0	0 - 1.0	0 - 2.0	1.0 - 4.0

The following table displays the potential number of casualties in Middlesex County by level of severity, for Richter Magnitudes 5.0 through 7.0.

Table 7.3.4-3:
Deterministic Earthquake Casualty Estimate for Middlesex County for Richter Magnitudes 5.0 through 7.0 (full upgrade geology); Potential Numbers of Casualties by Level of Severity.
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component, New Jersey Geologic Survey, 2003)

Casualty Type	5.0	5.5	6.0	6.5	7.0
Level 1 – Medical Aid	90 - 400	500 - 1,900	1,600 – 7,000	4,000 - 15,000	7,000 - 28,000
Level 2 – Hospital Care	10 - 50	90 -400	400 – 1,500	1,000 - 4,000	2,000 - 8,000
Level 3 – Life Threatening	< 20	10 - 40	50 - 200	150 - 600	300 - 1,200
Level 4 - Fatalities	< 20	20 - 80	100 -400	300 - 1,100	600 - 2,000

The following table displays the potential displaced households and public shelter requirements (in number of persons) in Middlesex County, for Richter Magnitudes 5.0 through 7.0.

Table 7.3.4-4:
Deterministic Earthquake Shelter Need Estimates for Middlesex County for Richter Magnitudes 5.0 through 7.0 (full upgrade geology); Potential Displaced Households and Public Shelter Requirements, in Numbers of Persons.
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component (New Jersey Geologic Survey, 2003)

Shelter Need Category	5.0	5.5	6.0	6.5	7.0
Displaced Households	140 – 500	1,200 – 5,000	5,000 – 19,000	10,000 - 40,000	17,000 - 68,000
Public Shelters	80 - 300	800 – 3,000	3,000 – 12,000	6,000 - 26,000	11,000 – 43,000

Table 7.3.4-5 displays the HAZUS loss estimation results for building damages in Middlesex County, for Richter Magnitudes 5.0 through 7.0 with full upgrade geology (see NJGS report). For each earthquake scenario, the table displays the number of buildings with moderate or greater damages, and the percentage of buildings in these damage categories vs. the number of buildings of those specific types in the county. Following this table is a series of maps that display the percent of buildings with moderate or greater damage for each scenario.

Table 7.3.4-5:
Moderate or Greater Building Damage Estimates (Count and Percentage) in Middlesex County for Richter Magnitudes 5.0 through 7.0 (full upgrade geology)
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component (New Jersey Geologic Survey, 2003)

	Total Buildings				5.5				Scenario		
Agriculture	93	0	0.00%	5	5.38%	19	20.43%	36	38.71%	51	54.84%
Commercial	4,727	90	1.90%	543	11.49%	1,671	35.35%	2,735	57.86%	3,618	76.54%
Education	257	2	0.78%	19	7.39%	63	24.51%	114	44.36%	158	61.48%
Government	19	0	0.00%	0	0.00%	0	0.00%	1	5.26%	1	5.26%
Industrial	1,858	25	1.35%	200	10.76%	642	34.55%	1,063	57.21%	1,412	76.00%
Religious	204	0	0.00%	10	4.90%	47	23.04%	88	43.14%	127	62.25%
Residential	167,199	2,285	1.37%	15,877	9.50%	39,729	23.76%	70,459	42.14%	97,551	58.34%
Total	**174,357**	**2,402**	**1.38%**	**16,654**	**9.55%**	**42,171**	**24.19%**	**74,496**	**42.73%**	**102,918**	**59.03%**

The following is a series of maps that displays the percentage of building damages (moderate or greater) in Middlesex County for Richter Scale Magnitudes 5.0 through 7.0.

Figure 7.3.4-3
Middlesex County: Richter Magnitude 5.0 Full Geology Upgrade Scenario: Percent of Buildings with Moderate or Greater Damage
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component (New Jersey Geologic Survey, 2003),

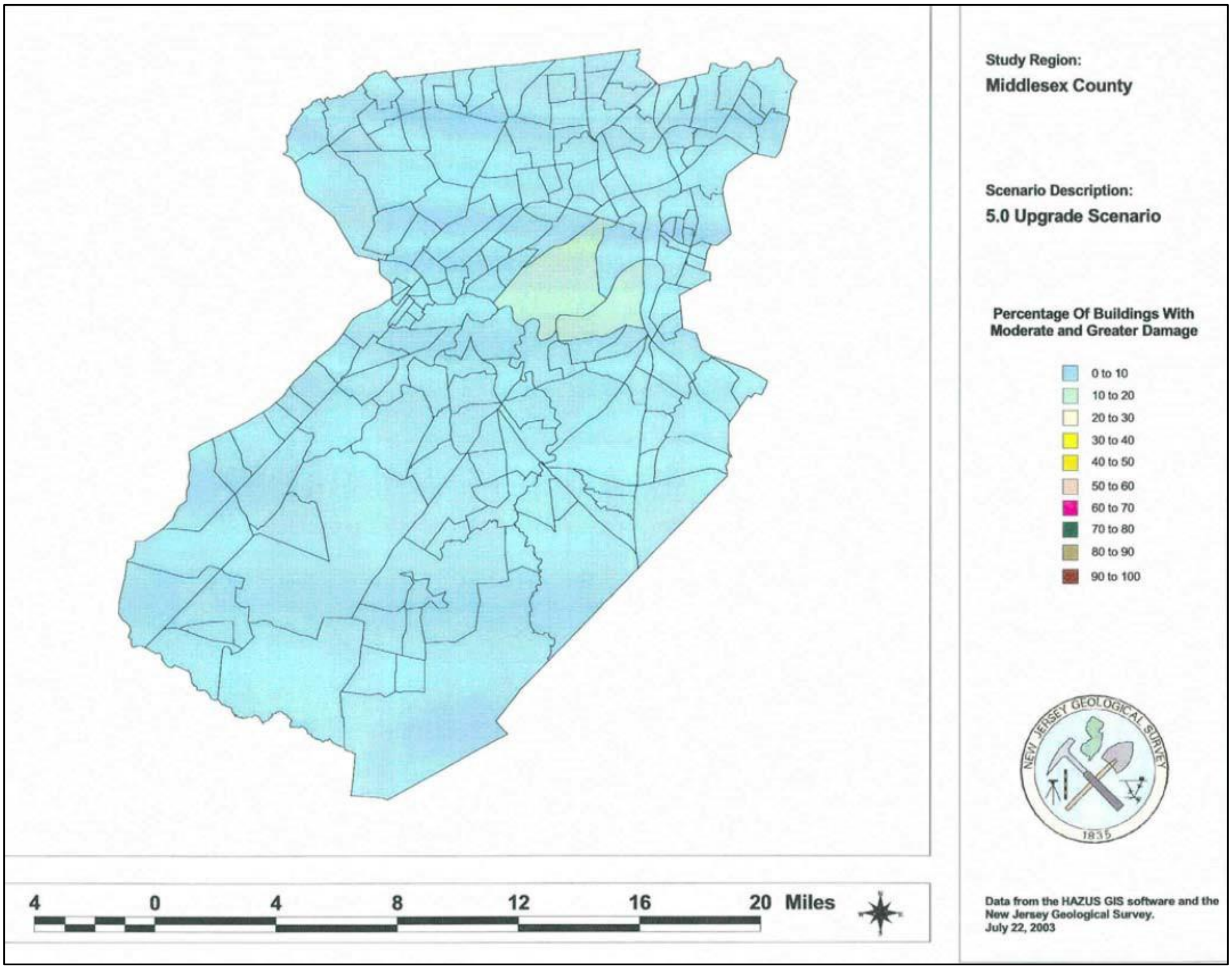


Figure 7.3.4-4
Middlesex County: Richter Magnitude 5.5 Full Geology Upgrade Scenario:
Percent of Buildings with Moderate or Greater Damage
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component (New Jersey Geologic Survey, 2003),

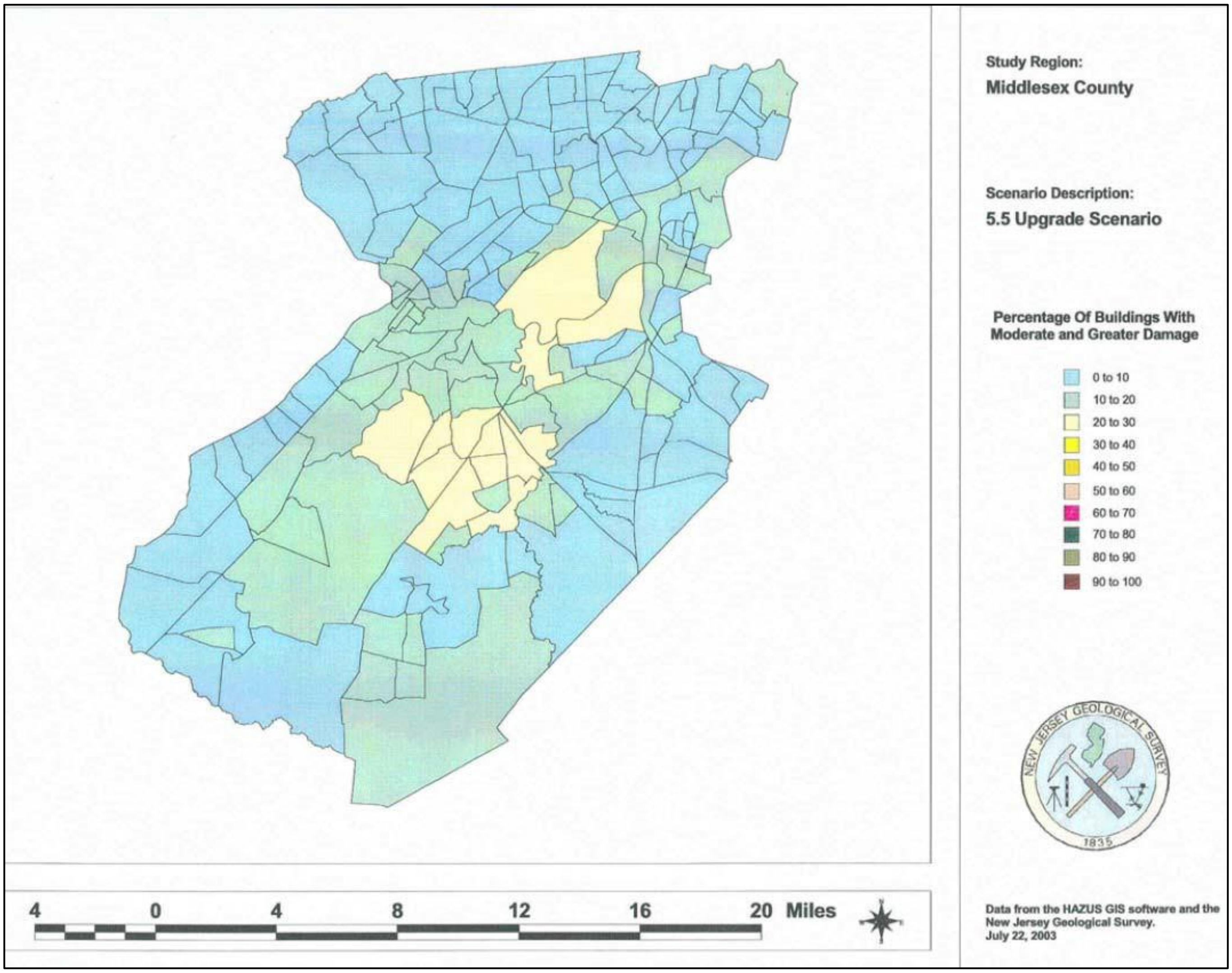


Figure 7.3.4-5
Middlesex County: Richter Magnitude 6.0 Full Geology Upgrade Scenario: Percent of Buildings with Moderate or Greater Damage
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component (New Jersey Geologic Survey, 2003),

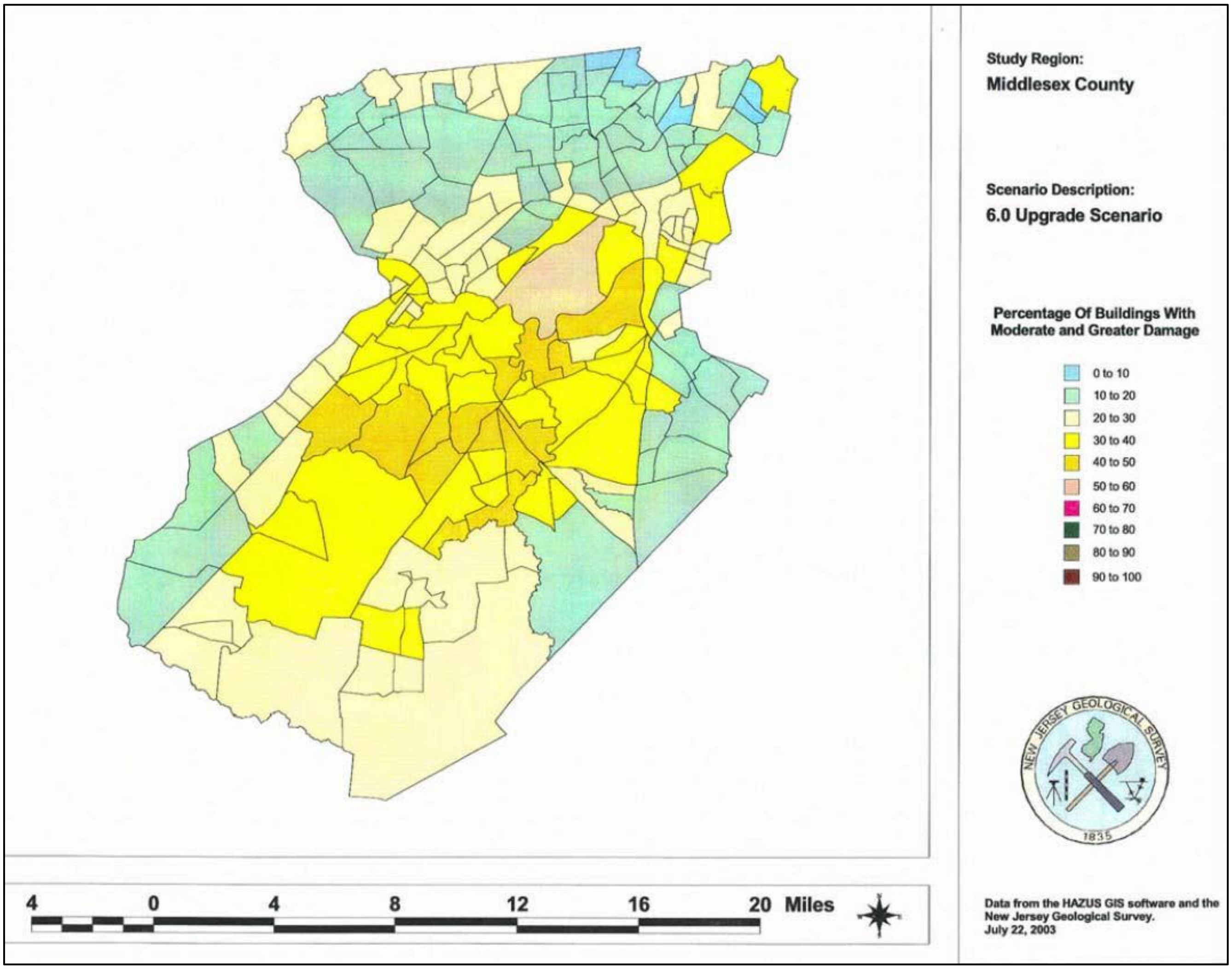


Figure 7.3.4-6
Middlesex County: Richter Magnitude 6.5 Full Geology Upgrade Scenario: Percent of Buildings with Moderate or Greater Damage
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component (New Jersey Geologic Survey, 2003),

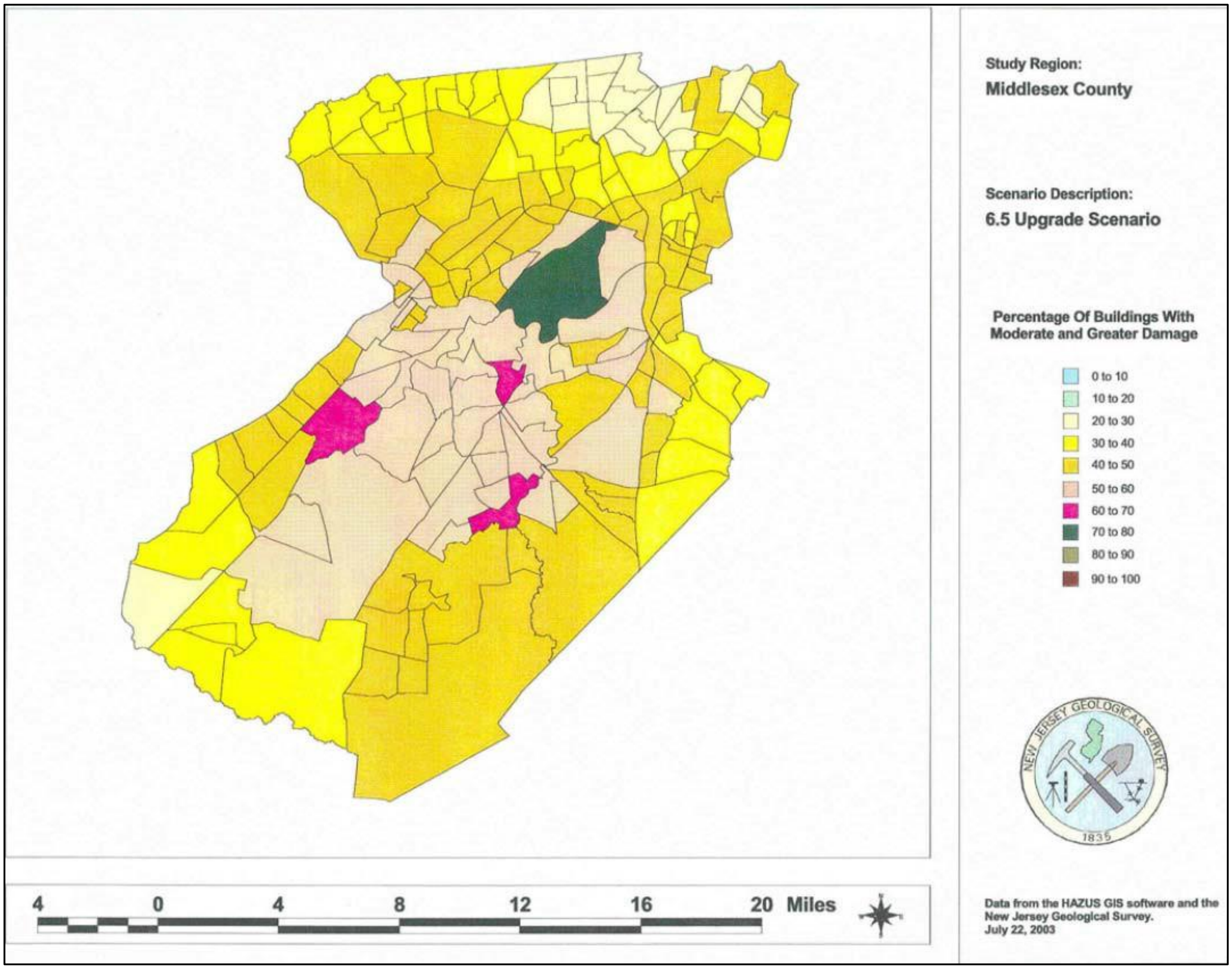
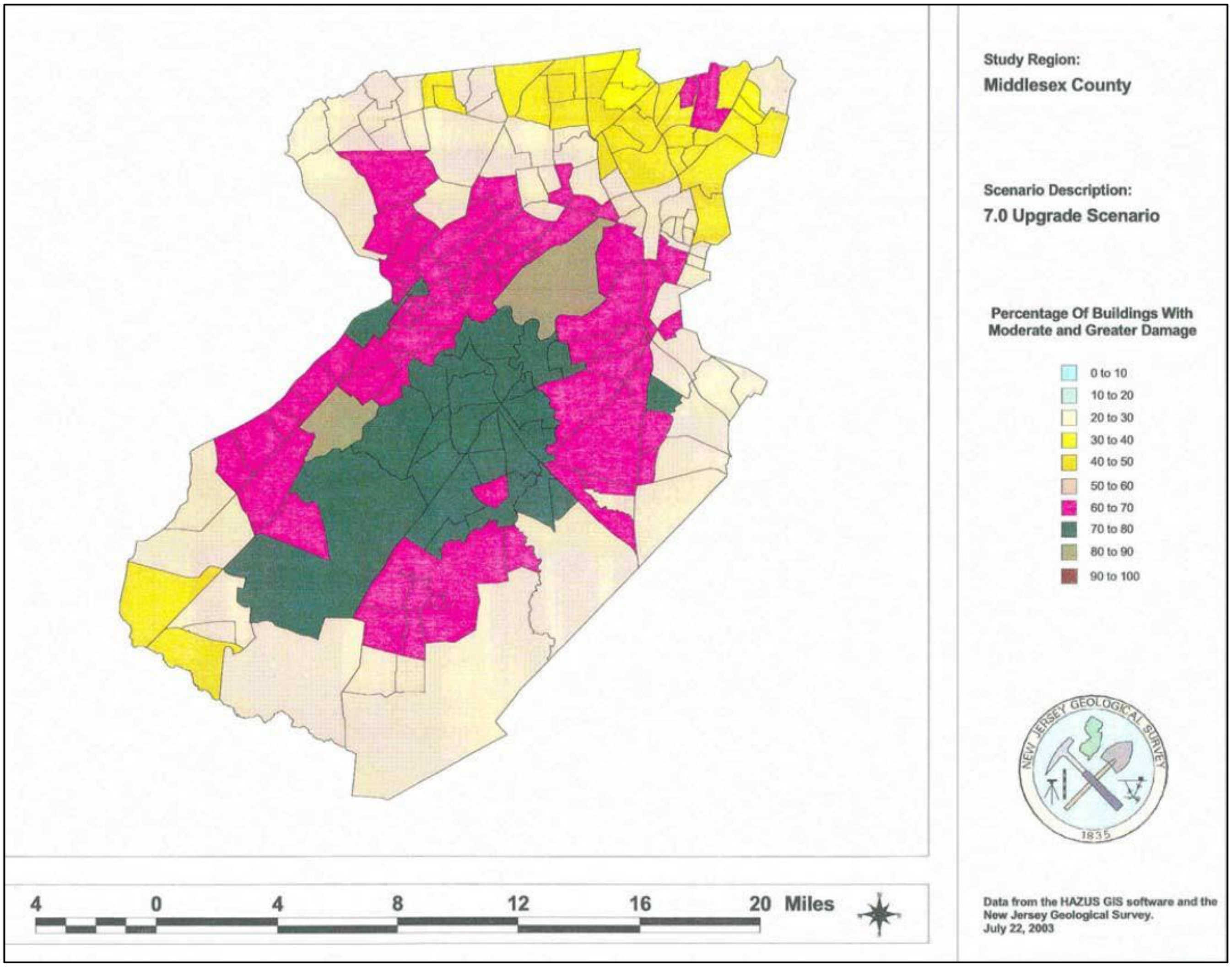


Figure 7.3.4-7
Middlesex County: Richter Magnitude 6.5 Full Geology Upgrade Scenario: Percent of Buildings with Moderate or Greater Damage
(Source: Earthquake Loss Estimation Study for Middlesex County, New Jersey: Geologic Component (New Jersey Geologic Survey, 2003),



Probabilistic Earthquake Risk Estimates

In addition to the deterministic earthquake risk assessments described above, which do not incorporate the probabilities of occurrence for the various scenarios, this section also includes probability-based risk estimates that were performed using the FEMA Full-Data Earthquake Benefit-Cost Analysis Module. Calculations were performed for two general asset classes: residential and non-residential. The non-residential class includes industrial, commercial, government, education and religious assets. As was the case with the hurricane wind risk calculations in a previous section, data regarding the square footage of these various assets was obtained through the HAZUS software. Note that the non-residential asset class of agriculture was not included in these calculations because of the assumed relatively low occupancy of such assets, and the difficulty of assigning a specific structural type to buildings.

Methodology

The FEMA Earthquake BCA software includes default shake data based on ZIP code. ZIP code 08882 was used for this analysis, as it was with the wind calculations, because of its fairly central location in the county. Table 7.3.4-6 shows the default annual probabilities for various levels of ground shaking, expressed as percent ground acceleration (PGA, a percentage of G [gravity]).

Table 7.3.4-6:
Earthquake Shake Probabilities for Central Point in Middlesex County, New Jersey
(Source: FEMA Full Data Earthquake BCA software default)

Level One Data

Seismic Hazard Wizard

Data Source: The user performed a hazard data look up with the provided USGS hazard data set. The user provided zipcode (08882). The geographic center for that zipcode has coordinates (lon \ lat) -74.38 \ 40.44. Hazard data was found for coordinates (lon \ lat) -74.4 \ 40.5, 3.45 miles to the north.

Identifying data for coordinates returned include:
Post Office Name: EDISON

Site Soil Type: Class D: Stiff soil V(30) 180 - 360 m/sec

Seismic Hazard Curve

PGA (%g)	4 - 8	8 - 16	16 - 32	32 - 55	55 - 80	80 - 100	> 100
Annual Probability	0.029037189	0.002991827	0.000765963	0.000272987	5.21544E-05	7.64275E-06	2.2942E-06

Risk to Residential Assets and People

The shake data is used in combination with information about the value, occupancy and seismic performance of the asset, to calculate annual and long-term risk. Specific residential building and occupancy parameters are summarized in Table 7.3.4-7 below.

Table 7.3.4-7:
Select Data Parameters for Middlesex County Earthquake Risk Estimate (Residential Assets)
(Source: FEMA Full Data Earthquake BCA software, HAZUS)

Data Type	Value	Note
Residential building type	Wood, light frame	FEMA BCA default W1
Residential structure replacement value	$125/s.f.	Estimated
Residential contents replacement value	$41.66/s.f.	FEMA default %
Displacement monthly rental cost	$1.00/s.f.	FEMA default
One time displacement cost	$1.00/s.f.	Estimated
Occupancy load	2.5 per 1,000/s.f.	Derived from census/HAZUS

These data are used in the FEMA BCA software module to calculate risk for residential assets. The following two figures show scenario damages to buildings and contents, and displacement costs, by level of shaking. The level of shaking is expressed in percent ground acceleration. The figures do not yet incorporate probabilities.

Table 7.3.4-8:
Scenario Building and Contents Damages, and Displacement Costs, by Level of Shaking (pga),
Residential Assets
(Source: FEMA Full Data Earthquake BCA software)

	SCENARIO DAMAGES BEFORE-MITIGATION ($ per event)						
PGA (% g)	Building Damages	Contents Damages	Displacement Costs	Business Losses	Rental Losses	Public/ Nonprofit	Total
4 - 8	$11,250	$0	$0	$0	$0	$0	$11,250
8 - 16	$133,750	$0	$0	$0	$0	$0	$133,750
16 - 32	$745,000	$2	$0	$0	$0	$0	$745,002
32 - 55	$2,178,750	$7	$400,003	$0	$0	$0	$2,578,760
55 - 80	$4,105,000	$14	$900,008	$0	$0	$0	$5,005,022
80 - 100	$5,772,500	$19	$1,200,011	$0	$0	$0	$6,972,530
> 100	$12,500,000	$25	$1,400,013	$0	$0	$0	$13,900,038

(1) Note: Figures are per 100,000 square feet of building area

Table 7.3.4-9 shows similar data related to casualties by level of shaking. The group of columns labeled *Scenario* shows the numbers of expected casualties by magnitude, as related to level of shaking (pga). The group of columns labeled *Expected Annual* shows the annual numbers of expected casualties by magnitude, as related to level of shaking (pga).

Table 7.3.4-9:
Scenario Injuries and Deaths by Level of Shaking (pga), *Residential Assets*
(Source: FEMA Full Data Earthquake BCA software)

CASUALTIES BEFORE-MITIGATION (number)							
PGA	Building	SCENARIO			EXPECTED ANNUAL		
(%g)	SDF (%)	Minor	Major	Deaths	Minor	Major	Deaths
4 - 8	0.09	3.00E-02	0.00E+00	0.00E+00	8.71E-04	0.00E+00	0.00E+00
8 - 16	1.07	6.30E-01	1.20E-01	4.50E-02	1.88E-03	3.59E-04	1.35E-04
16 - 32	5.96	7.22E+00	2.84E+00	1.25E+00	5.53E-03	2.17E-03	9.54E-04
32 - 55	17.43	4.04E+01	2.59E+01	1.24E+01	1.10E-02	7.06E-03	3.38E-03
55 - 80	32.84	1.13E+02	8.89E+01	4.35E+01	5.88E-03	4.63E-03	2.27E-03
80 - 100	46.18	1.91E+02	1.64E+02	8.11E+01	1.46E-03	1.26E-03	6.20E-04
> 100	60.75	2.89E+02	2.63E+02	1.30E+02	6.63E-04	6.03E-04	2.99E-04
				Totals:	2.73E-02	1.61E-02	7.66E-03

(1)Figures are per 100,000 square feet of building area

Risk to Non-Residential Assets, Operations and People

This subsection addresses estimated earthquake risk to non-residential assets, operations and people. As noted earlier, non-residential assets were combined into a single category in order to simplify the analysis. Basic data parameters are provided in the table below.

Table 7.3.4-10:
Select Data Parameters for Middlesex County Earthquake Risk Estimate *(Non-residential Assets)*
(Source: FEMA Full Data Earthquake BCA software, HAZUS)

Data Type	Value	Note
Non-residential building type	Steel frame/unreinforced masonry	Average of types
Non-residential structure replacement value	$140/s.f.	Estimated
Non-residential contents replacement value	$140/s.f.	Estimated
Displacement monthly rental cost	$1.00/s.f.	FEMA default
One time displacement cost	$1.00/s.f.	Estimated
Occupancy load	10 per 1,000/s.f.	Derived from US Census/HAZUS

These data are used in the FEMA BCA software module to calculate risk for non-residential assets. The following two figures show scenario damages to buildings and contents, displacement costs and operational business losses, by level of shaking. The level of shaking is expressed in percent ground acceleration (pga). The figures do not yet incorporate probabilities. Note that in order to streamline the analysis, public and non-profit losses were not separately calculated; when facility-specific calculations are required, the FEMA BCA software requires inputs for annual budgets of public and non-profit operations, which must be determined on an individual basis.

Table 7.3.4-11:
Scenario Building and Contents Damages, and Displacement Costs, by Level of Shaking (pga), ***Non-Residential Assets***
(Source: FEMA Full Data Earthquake BCA software)

	SCENARIO DAMAGES BEFORE-MITIGATION ($ per event)						
PGA (% g)	Building Damages	Contents Damages	Displacement Costs	Business Losses	Rental Losses	Public/ Nonprofit	Total
4 - 8	$228,200	$228,200	$0	$1,000,000	$0	$0	$1,456,400
8 - 16	$1,456,000	$1,456,000	$400,002	$5,000,000	$0	$0	$8,312,002
16 - 32	$4,902,800	$4,902,800	$1,300,008	$15,000,000	$0	$0	$26,105,608
32 - 55	$14,000,000	$9,150,400	$2,050,013	$15,000,000	$0	$0	$40,200,413
55 - 80	$14,000,000	$11,765,600	$2,050,013	$15,000,000	$0	$0	$42,815,613
80 - 100	$14,000,000	$12,870,200	$2,050,013	$15,000,000	$0	$0	$43,920,213
> 100	$14,000,000	$13,510,000	$2,050,013	$15,000,000	$0	$0	$44,560,013

(1) Figures are per 100,000 square feet of building area

Table 7.3.4-12 shows similar data related to casualties by level of shaking. The group of columns labeled *Scenario* shows the numbers of expected casualties by magnitude, as related to level of shaking (pga). The group of columns labeled *Expected Annual* shows the annual numbers of expected casualties by magnitude, as related to level of shaking (pga).

Table 7.3.4-12:
Scenario Injuries and Deaths by Level of Shaking (pga), ***Non-residential Assets***
(Source: FEMA Full Data Earthquake BCA software)

CASUALTIES BEFORE-MITIGATION (number)							
PGA	Building	SCENARIO			EXPECTED ANNUAL		
(%g)	SDF (%)	Minor	Major	Deaths	Minor	Major	Deaths
4 - 8	0.09	3.00E-02	0.00E+00	0.00E+00	8.71E-04	0.00E+00	0.00E+00
8 - 16	1.07	6.30E-01	1.20E-01	4.50E-02	1.88E-03	3.59E-04	1.35E-04
16 - 32	5.96	7.22E+00	2.84E+00	1.25E+00	5.53E-03	2.17E-03	9.54E-04
32 - 55	17.43	4.04E+01	2.59E+01	1.24E+01	1.10E-02	7.06E-03	3.38E-03
55 - 80	32.84	1.13E+02	8.89E+01	4.35E+01	5.88E-03	4.63E-03	2.27E-03
80 - 100	46.18	1.91E+02	1.64E+02	8.11E+01	1.46E-03	1.26E-03	6.20E-04
> 100	60.75	2.89E+02	2.63E+02	1.30E+02	6.63E-04	6.03E-04	2.99E-04
				Totals:	2.73E-02	1.61E-02	7.66E-03

(1) Figures are per 100,000 square feet of building area

Earthquake Risk Estimates to Residential and Non-Residential Assets

Tables 7.3.4-13 and 7.3.4-14 summarize earthquake risk to Middlesex County assets, operations and people. It must be noted that these calculations are based on broad estimates of building types, occupancies and soil characteristics. Northern New Jersey has a moderate degree of known earthquake risk that is related to both the presence of faults and the amounts of built environment and people. In many cases, particularly where critical facilities are involved, jurisdictions should initiate limited studies of these facilities in order to identify on a site-specific basis where there are significant risks from earthquakes. The information in this section should be used for planning purposes only, i.e. as the basis for additional steps in risk assessment, and eventually (where warranted) targeted mitigation actions to reduce the risk.

Table 7.3.4-13:
Summary of Estimated Earthquake Risk to Middlesex County Assets and Operations
(Source: FEMA Full Data Earthquake BCA software)

	Building	Contents		Business Loss	
Residential	$6,552,602	$0	$508,210	$0	$7,060,812
Non-residential	$13,863,900	$12,949,195	$2,073,571	$43,583,163	$72,469,829
Total	**$20,416,501**	**$12,949,195**	**$2,581,781**	**$43,583,163**	**$79,530,640**

Table 7.3.4-14:
Estimated Casualty-Related Earthquake Risk in Middlesex County
(Source: FEMA Full Data Earthquake BCA software)

	Residential					
Magnitude	**Minor**	**Major**	**Death**	**Minor**	**Major**	**Death**
Rate per 100K s.f.	0.0273	0.0161	0.00766	0.0941	0.0666	0.0322
County						
Middlesex	$985,146	$968,306	$69,104,537	$813,295	$959,360	$71,347,839

HAZUS Earthquake Loss Estimates in Middlesex County

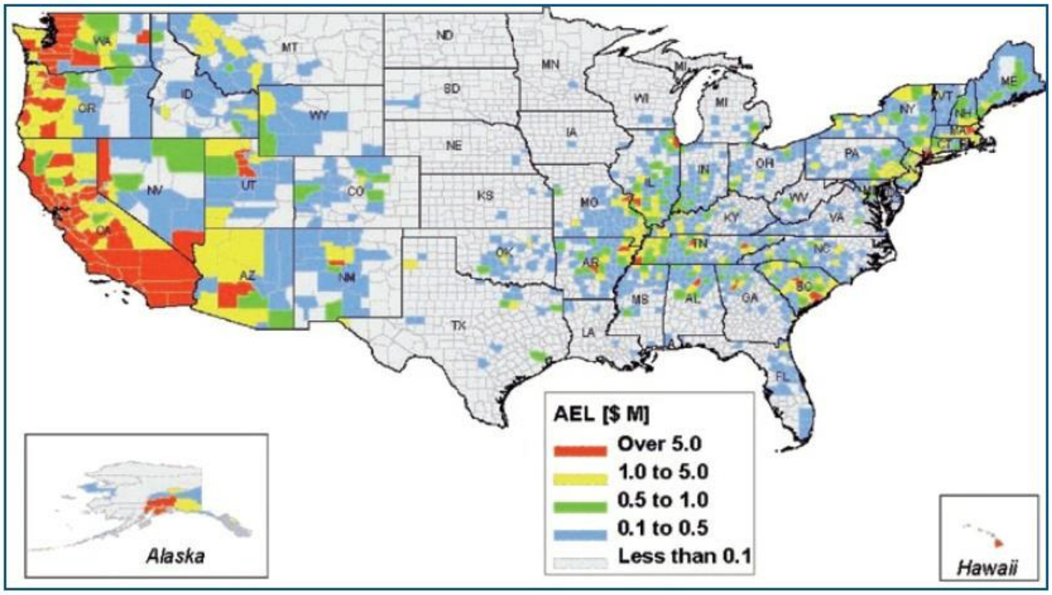
In addition to analyzing the *Earthquake Loss Estimation Study for Middlesex County*, earthquake loss estimates for the County were also estimated from the FEMA document titled, *HAZUS Multi-Hazard (MH) Estimated Annualized Earthquake Losses for the United States.* This document, produced in April 2008, provides annualized earthquake loss estimates at the national, regional, State, and County levels. The study highlights the impacts of both high risk and high exposure on losses caused by earthquakes. It is based on loss estimates generated by HAZUS-MH, a geographic information system (GIS)-based earthquake loss estimation tool developed by FEMA in cooperation with the National Institute of Building Sciences (NIBS). The HAZUS tool provides a method for quantifying future earthquake losses[4].

To calculate the earthquake loss estimates the building replacement value of the building inventory was estimated. The estimated replacement value was based on the structural building value only and did not include the land or building contents. The study estimated that the building inventory replacement value for most Counties in New Jersey, including Middlesex, was between $10 and $50 billion.

The results of the study indicated that New Jersey has a relatively low hazard risk with a high building inventory in comparison to the rest of the nation. The study results shows that New Jersey ranks 14th nationally in estimated annual earthquake losses with $39.7 million in annual losses. As shown in Figure 7.3.4-8, the annual estimated earthquake losses for counties in northern New Jersey, including Middlesex County, were estimated from $1 to $5 million.

[4] FEMA *HAZUS Multi-Hazard (MH) Estimated Annualized Earthquake Losses for the United States*

Figure 7.3.4-8
Annual Earthquake Losses (AEL)
(Source: HAZUS Multi-Hazard (MH)
Estimated Annualized Earthquake Losses for the United States, April, 2008*)*



7.3.5 Hazardous Materials Risk in Middlesex County

This subsection describes the risk assessment for hazardous materials in Middlesex County. Section 6 of this plan separates hazardous materials into two categories that include fixed site locations and releases related to transportation. This same approach is also applied to the risk assessment below, with hazardous materials divided into the same categories.

Hazardous Materials – Fixed Site

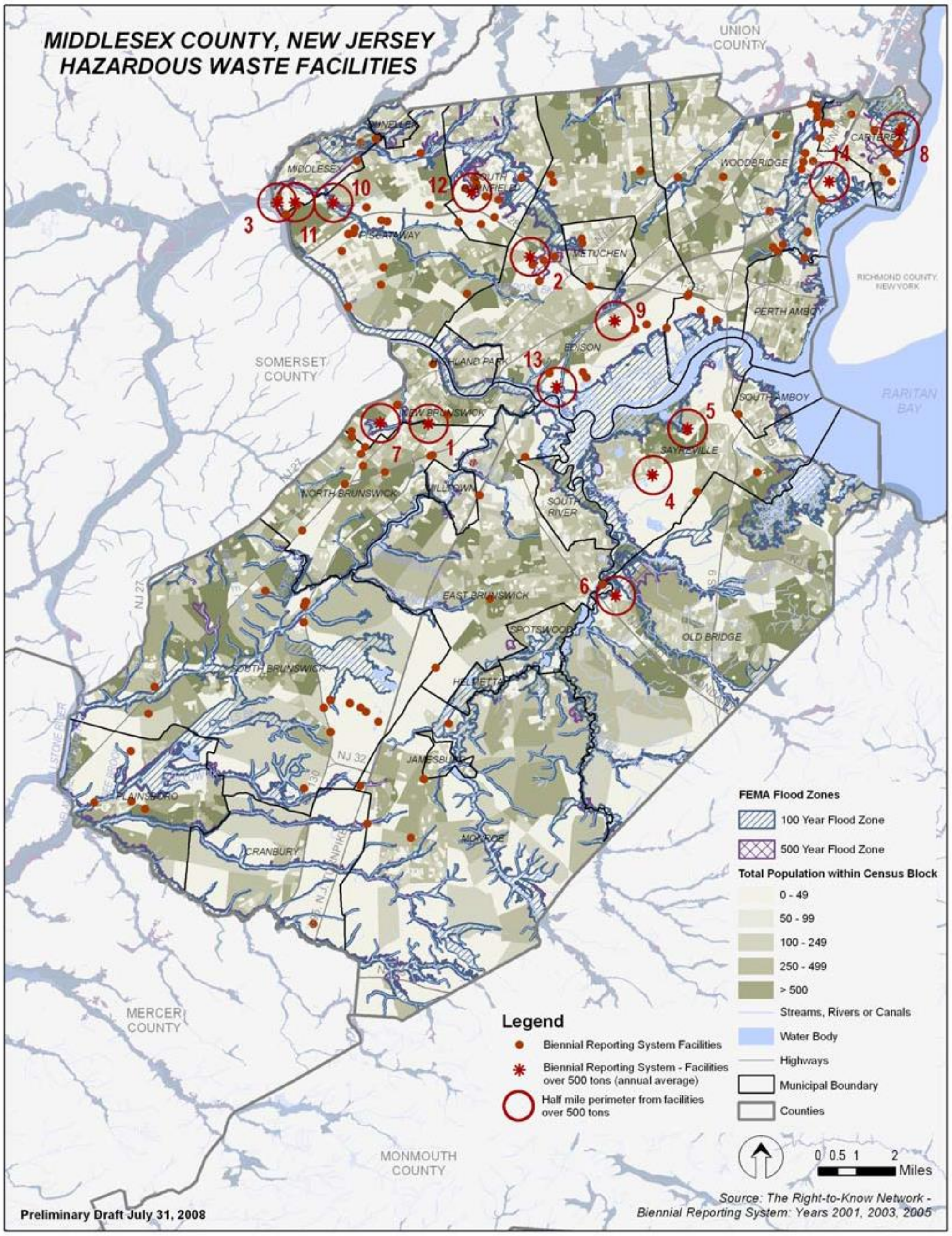
As described in Section 6, there does not appear to be a single comprehensive source that includes an inventory of all hazardous materials. The risk assessment for the fixed site locations was based on data obtained from several US Environmental Protection Agency (EPA) databases. To identify hazardous waste sites, the EPA Biennial Reporting System (BRS) was queried through the Right-to-Know (RTK) Network for the years 2001, 2003, and 2005, the three most recent years available within the database. To identify facility releases, the EPA Toxic Release Inventory (TRI) database was queried for the same reporting years: 2001, 2003, and 2005. Additional details about both the BRS and TRI databases can be found in Section 6 of this plan.

The BRS is one of EPA's primary tools for tracking the generation, shipment, and receipt of hazardous waste. According to the Right-to-Know Network, the BRS appears to be the best US hazardous waste tracking database. The number of facilities, tons generated, and tons managed within Middlesex County are summarized in Section 6 of this plan (Table 6.3.9-2: Hazardous Waste, 2001-2005).

As part of the risk assessment for hazardous materials, the waste facilities from the BRS were combined for the three reporting years and the average annual tons generated for each site was averaged in order to rank the facilities.

Figure 7.3.5-1 is a map of the hazardous waste facilities identified within the BRS database for years 2001, 2003, and 2005. Facilities with an average in excess of 500 tons generated over the three reporting years are shown with a circle to capture the population, housing units and number of acres in the floodplain within a 0.5 mile radius. The 500-ton threshold was used to identify roughly the top ten percent of facilities listed in the database.

Figure 7.3.5-1
Middlesex County: Hazardous Waste Facilities, reporting years 2001, 2003, and 2005
(Source: The Right-to-Know Network – Biennial Reporting System)



(1) Seven of the 21 hazardous waste facilities with an average waste generated over 500 tons for the three reporting years could not be mapped because of inconsistencies in the public-source data from the BRS, and were therefore excluded from this version of the hazard mitigation plan.

The following two tables (Table 7.3.5-1 and 7.3.5-2) summarize the population, number of housing units, and number of acres in the floodplain within a 0.5 mile perimeter for 14 of the 21 facilities with an average over 500 tons generated for reporting years 2001, 2003, and 2005. Each 0.5 mile perimeter displayed on the map is a total of 502 acres. The floodplain columns within the tables below identify the portion of the area inside this radius that is located within the 100-year and 500-year floodplain.

Table 7.3.5-1 shows that Map Identification (ID) number 1 located in the municipality of New Brunswick has the highest population inside the 0.5-mile radius among the 14 facilities with an average generated waste in excess of 500 tons. At this facility, the average tons generated over the three reporting years was 787 tons, which ranked ninth among the 14 total facilities. The table also shows that Map ID number 3 has highest number of acres in the 100-year floodplain with just over 217 acres, or 43% of the 0.5 mile perimeter. This is followed by Map ID number 8 with 176 acres, or 35% of the land area, located within the 100-year floodplain.

Table 7.3.5-1:
Middlesex County: Population and Housing Units within a 0.5 mile perimeter for facilities generating an average of 500 tons, reporting years 2001, 2003, and 2005, Ordered by Population Count
(Source: The Right-to-Know Network – Biennial Reporting System)

Map ID	Population	Housing Units	Facility in Floodplain (Y/N)	# of Acres in 100-Year Floodplain	# of Acres in 500-Year Floodplain	Average Annual Waste Generated (in Tons)
1	8,695	2,845	Yes	6.97	1.92	787
2	5,554	2,153	No	3.07	100.13	802
3	5,216	2,018	Yes	217.17	26.47	594
4	4,897	1,908	No	0.0	0.0	643
5	4,361	1,717	No	59.80	8.43	10,495
6	3,624	1,157	No	198.72	27.92	4,045
7	3,570	1,358	Yes	47.34	39.08	5,873
8	3,397	1,060	Yes	176.04	166.00	906
9	3,175	1,369	No	18.35	22.63	828
10	3,078	1,219	Yes	89.36	22.83	573
11	2,747	1,108	No	56.63	21.57	35,993
12	2,422	860	No	0.33	71.10	599
13	1,706	633	No	101.72	4.42	567
14	1,473	524	No	86.63	28.74	841

Table 7.3.5-2 shows that Map ID number 11 located in Middlesex Borough had the highest average tons generated of the 14 facilities highlighted with a 0.5 mile perimeter on the map. At this facility the average tons generated over the three reporting years was 35,993 tons. The total population within a 0.5 mile perimeter of this facility was 2,747, which ranked eleventh in population for the 14 total facilities.

Table 7.3.5-2:
Middlesex County: Population and Housing Units within a 0.5 mile perimeter for facilities generating an average of 500 tons, reporting years 2001, 2003, and 2005, Ordered by Average Tons
(Source: The Right-to-Know Network – Biennial Reporting System)

Map ID	Average Annual Waste Generated (in Tons)	Population	Housing Units	# of Acres in 100-Year Floodplain	# of Acres in 500 Year Floodplain
11	35,993	2,747	1,108	56.63	21.57
5	10,495	4,361	1,717	59.80	8.43
7	5,873	3,570	1,358	47.34	39.08
6	4,045	3,624	1,157	198.72	27.92
8	906	3,397	1,060	176.04	166.00
14	841	1,473	524	86.63	28.74
9	828	3,175	1,369	18.35	22.63
2	802	5,554	2,153	3.07	100.13
1	787	8,695	2,845	6.97	1.92
4	643	4,897	1,908	0.0	0.0
12	599	2,422	860	0.33	71.10
3	594	5,216	2,018	217.17	26.47
10	573	3,078	1,219	89.36	22.83
13	567	1,706	633	101.72	4.42

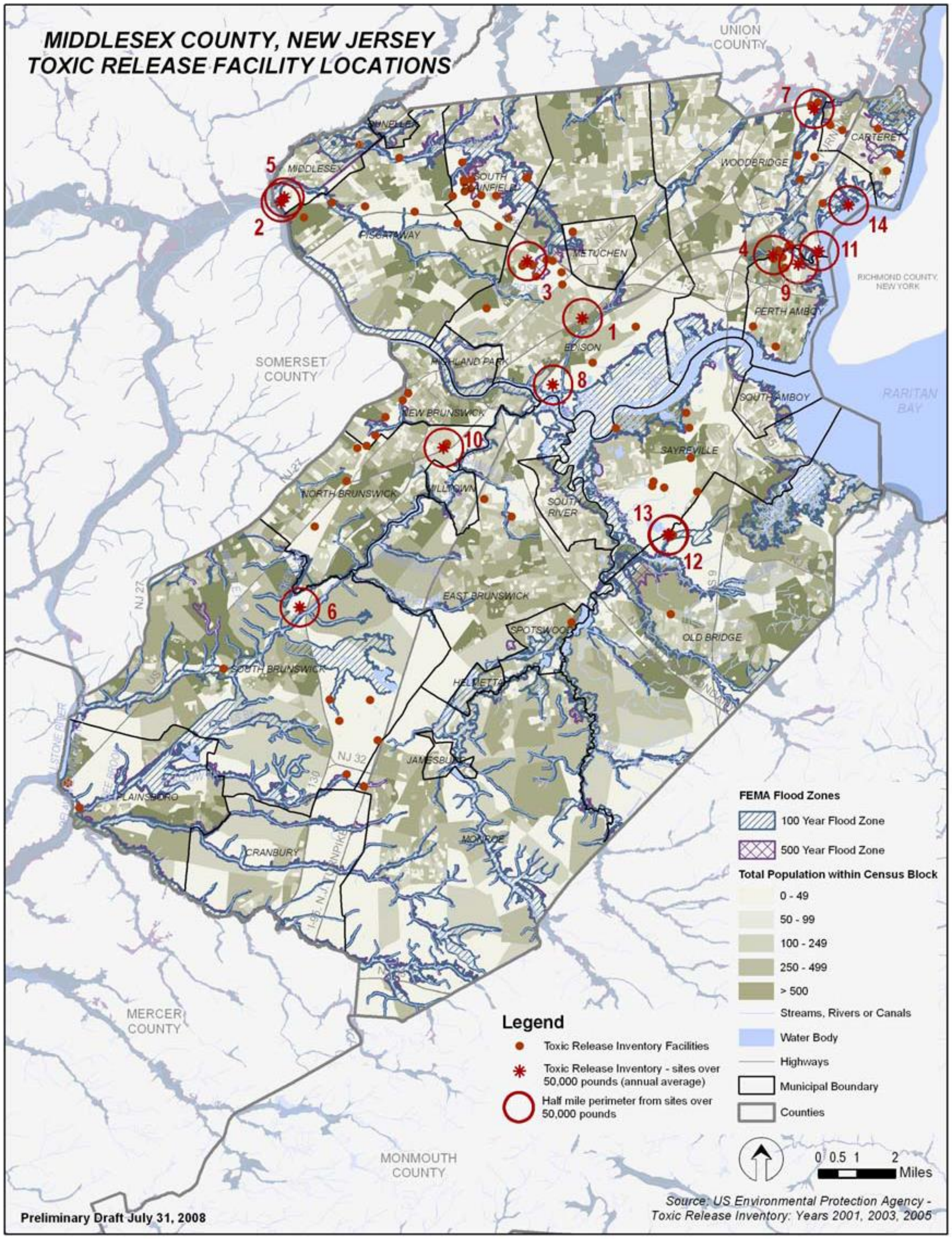
The TRI database captures data related to releases and transfers of toxic chemicals from large facilities. As described in Section 6 of this plan, beginning in 1986 as part of the Emergency Planning and Community Right-to-know Act (EPCRA), certain industries as well as federal facilities have been required to report the locations and quantities of chemicals stored on-site to state and local governments in order to help communities prepare to respond to chemical spills and similar emergencies. EPCRA Section 313 requires the EPA and the States to annually collect data on releases and transfers of certain toxic chemicals from industrial facilities, and make the data available to the public as part of the Toxics Release Inventory (TRI) [5].

In Section 6, results from the TRI database are shown for reporting years 2000 through 2006, the most recent year available. The total onsite and off-site disposal or releases is reported in pounds, and includes facilities for all types of industries and chemicals in Middlesex County (See Table 6.3.9-7 in the past occurrences of the hazardous materials – fixed site section). Similar to the BRS, the list of TRI facilities was combined for the three reporting years and the average annual toxic releases for each site was averaged in order to rank the facilities.

Figure 7.3.5-2 is a map of the facilities identified within the TRI database for years 2001, 2003, and 2005. Facilities with average toxic chemical releases in excess of 50,000 pounds over the three reporting years are shown with a circle to capture the population, housing units and number of acres in the floodplain within a .5 mile radius. The threshold of 50,000 pounds was selected to provide additional details related to roughly the top ten percent of facilities listed in the database.

[5] : EPA – TRI Program

Figure 7.3.5-2
Middlesex County: Toxic Release Facility Locations, reporting years 2001, 2003, and 2005
(Source: EPA – Toxic Release Inventory Program)



The following two tables (Table 7.3.5-3, and 7.3.5-4) summarize the population, number of housing units, and number of acres in the floodplain within a 0.5 mile perimeter for the 14 facilities with toxic releases averaging over 50,000 pounds for reporting years 2001, 2003, and 2005. Similar to the Hazardous Waste Facility map, each .5 mile perimeter displayed on the map is a total of 502 acres. The floodplain columns within the tables below identify the portion of the total perimeter that is located within the 100-year and 500-year floodplain.

Table 7.3.5-3 shows that Map ID number 1 located in Edison Township has the highest population of the 14 facilities with toxic releases averaging over 50,000 pounds. At this facility, the average releases over the three reporting years were 319,609 pounds, which ranked second among the 14 total facilities. The table also shows that Map ID number 11 has highest number of acres in the 100-year floodplain with just over 316 acres, or 63% of the .5 mile perimeter. This is followed by Map ID number 14 with 304 acres, or 60% of the land area, located within the 100-year floodplain.

Table 7.3.5-3:
Middlesex County: Population and Housing Units within a 0.5 mile perimeter for facilities releasing an average of 50,000 pounds, reporting years 2001, 2003, and 2005, Ordered by Population Count
(Sources: EPA – Toxic Release Inventory Program, 2000 US Census Bureau)

Map ID	Population	Housing Units	Facility in Floodplain (Y/N)	# of Acres in 100-Year Floodplain	# of Acres in 500-Year Floodplain	Average Annual Release (in Pounds)
1	4,764	1,903	No	7.3	0.0	319,609
2	4,639	1,817	No	181.0	27.3	462,142
3	4,336	1,689	No	0.0	81.2	59,252
4	4,119	1,555	No	40.3	5.0	69,887
5	3,896	1,533	No	199.0	35.8	73,670
6	2,831	1,225	No	86.8	9.2	63,240
7	1,965	866	No	74.3	37.8	57,919
8	1,886	697	No	111.2	4.7	71,336
9	1,626	566	No	228.0	25.4	69,506
10	1,324	530	No	0.2	0.4	202,564
11	582	216	No	316.4	12.2	94,650
12	39	13	No	122.0	6.2	1,026,324
13	39	13	No	124.8	5.3	1,735,413
14	5	3	No	304.1	65.2	155,735

Table 7.3.5-4 shows that Map ID number 13 located in Old Bridge Township had the highest average releases of the 14 facilities highlighted with a 0.5 mile radius on the map. At this facility the average toxic releases over the three reporting years was slightly more than 1.7 million pounds. The total population within a.5 mile perimeter of this facility was 39, which ranked tied for 12th in population for the 14 total facilities.

Table 7.3.5-4:
Middlesex County: Population and Housing Units within a 0.5 mile perimeter for facilities releasing an average of 50,000 pounds, reporting years 2001, 2003, and 2005, Ordered by Average Releases
(Sources: EPA – Toxic Release Inventory Program, 2000 US Census Bureau)

Map ID	Average Annual Release (in Pounds)	Population	Housing Units	# of Acres in 100-Year Floodplain	# of Acres in 500 Year Floodplain
13	1,735,413	39	13	124.8	5.3
12	1,026,324	39	13	122.0	6.2
2	462,142	4,639	1,817	181.0	27.3
1	319,609	4,764	1,903	7.3	0.0
10	202,564	1,324	530	0.2	0.4
14	155,735	5	3	304.1	65.2
11	94,650	582	216	316.4	12.2
5	73,670	3,896	1,533	199.0	35.8
8	71,336	1,886	697	111.2	4.7
4	69,887	4,119	1,555	40.3	5.0
9	69,506	1626	566	228.0	25.4
6	63,240	2,831	1,225	86.8	9.2
3	59,252	4,336	1,689	0.0	81.2
7	57,919	1965	866	74.3	37.8

The present section is closer to a vulnerability assessment than a calculation of expected future damages. The information above is intended only as a general characterization of exposure based on open-source information from the EPA and other public organizations. The sources that are discussed here and in Section 6 of this document mainly refer to various public databases, most of which are designed to support site-specific queries, not larger-scale planning exercises. Planners requiring more detailed information about particular areas are encouraged to use these resources, and to consult with the local RTK coordinators, who are listed on the RTK web site. It should also be clearly understood that these databases are updated occasionally, so at some point the data included in this plan will be superseded by more current information.

Note that an action item has been added in the Mitigation Strategies section to review the street address for the facilities identified from the BRS that were unable to be mapped as part of Figure 7.3.5-2. Accurate street address data will be obtained so these missing facilities can be mapped as part of future plan updates.

Hazardous Materials – Transportation

As noted in Section 6 of this plan, the Emergency Response Notification Database tracks hazardous materials incidents related to transportation, and these are summarized in tabular form in that section. Although a sufficiently long record of events could form the basis of cursory risk assessment, hazards such as these are essentially non-probabilistic, so the result of this is that any estimation of damages inherently has a very high degree of uncertainty.

7.3.6 Dam Failure Risk in Middlesex County

This subsection of the plan discusses the dam failure risk in Middlesex County. As described in Section 6, Hazard Identification and Profiling, the New Jersey Department of Environmental Protection (NJDEP) – Bureau of Dam Safety and Flood Control indentifies 38 dams in Middlesex County. In Section 6, Table 6.3.1-2 lists these dams, including the NJDEP hazard classification, which ranks the potential for loss of life and infrastructure and property damages downstream if a dam failure were to occur. The NJDEP has established three hazard classifications: high (H), significant (S), and low (L). See Table 6.3.1-2 in Section 6 for a list of the dams and hazard classifications. The descriptions of the hazard classifications at the bottom of the table are repeated below

- H = High Hazard: Loss of life likely (if failure were to occur)
- S = Significant Hazard: Loss of life not likely but the potential for significant property damage
- L = Low Hazard: Loss of life not likely and minimal infrastructure or property damage other than the structure itself

The Middlesex County Hazard Mitigation Steering Committee (HMSC) reviewed the inventory of dams from the NJDEP and determined that the Brainerd Lake Dam in Cranbury Township and the Green Street Dam in Woodbridge Township would be selected for further analysis as part of the dam failure risk assessment. Both dams are classified as Significant Hazard dams by the NJDEP. The two dams are summarized below in Table 7.3.6-1.

Table 7.3.6-1:
Summary of Middlesex County Dams Selected for Risk Assessment
(Source: NJDEP – Bureau of Dam Safety and Flood Control)

Municipality Name	Dam Name	River/Stream	Height (ft)	Length (feet)	Last Date Inspected
Cranbury Township	Brainerd Lake Dam	Cranbury Brook	12.5	382	11/6/2007
Woodbridge Township	Green Street Dam	Rahway River	8	755	4/13/2007

The HMSC and its consulting engineers determined that to estimate downstream dam failure vulnerabilities, a geographic information system would be used to establish a 500-foot-wide stream buffer extending 1.5 miles downstream of each high hazard dam. This area is then used in combination with population, housing and land use data to determine the degree of exposure downstream. The downstream buffer is shown only to identify the population and development downstream of the dam. *It is important to note that the buffer zone is intended for general planning purposes only, and does not indicate the downstream inundation area if a dam failure were to occur. Inundation areas and zones of potential high- velocity flow are highly site-specific and require detailed engineering study to accurately characterize risk.*

Figures 7.3.6-1 and 7.3.6-2 show commercial, industrial, and residential land use types for each census block intersecting the 500 foot buffer downstream of both dams. Each map is followed by two tables (Tables 7.3.6-2 – 7.3.6-5) that identify the population, housing units and the number of acres for each land use category displayed on the map.

Figure 7.3.6-1 is a map of Brainerd Lake Dam located along Cranbury Brook in Cranbury Township. The map identifies the land use / land cover for the census blocks intersecting a 500 foot wide stream buffer.

Figure 7.3.6-1
Brainerd Lake Dam
Land Use / Land Cover for Census Blocks Intersecting a 500 Foot-Wide Buffer
(Source: NJDEP)

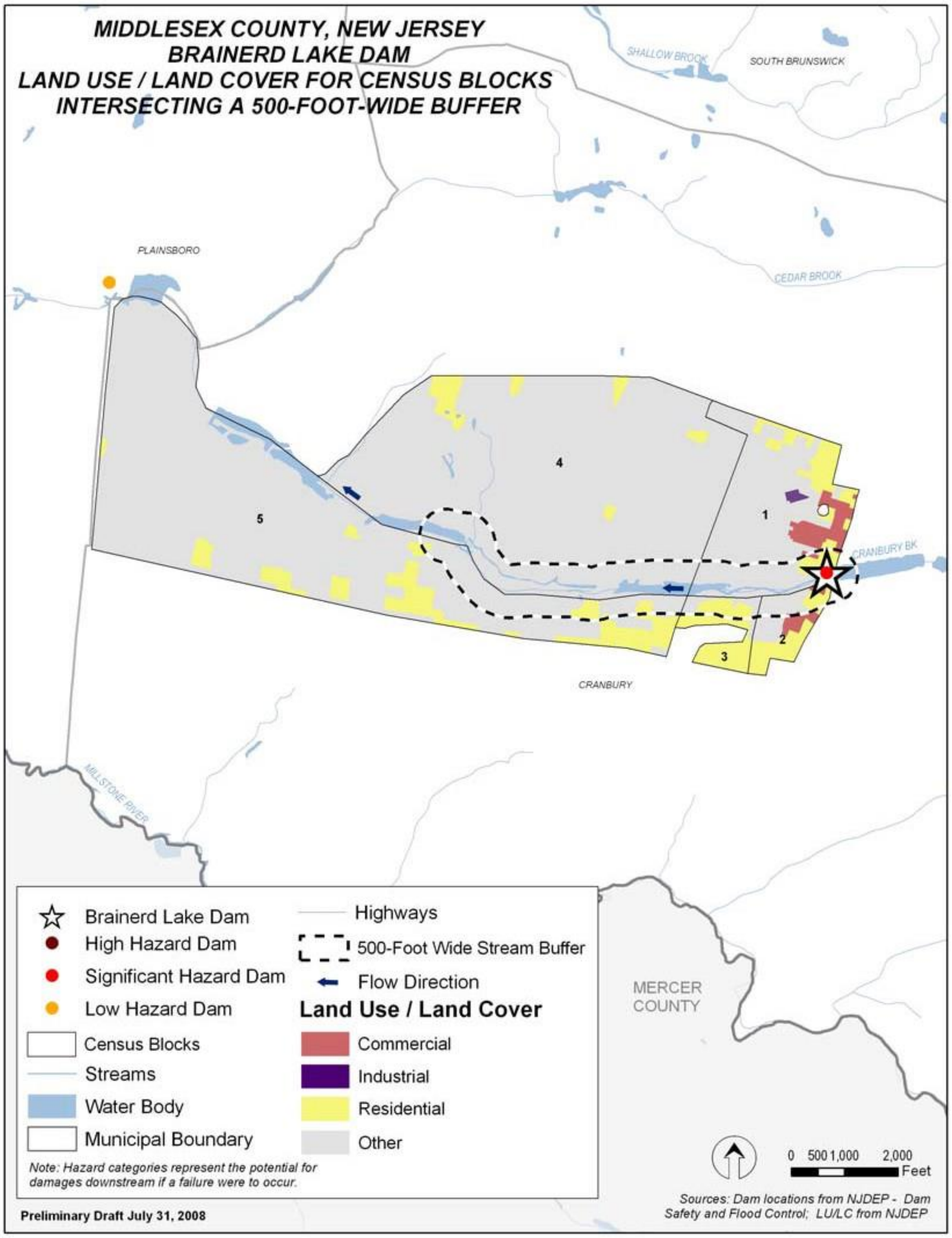


Table 7.3.6-2 identifies the population and housing units for each of the five census blocks included on the Brainerd Lake Dam map (Figure 7.3.6-1). There are a total of 345 residents and 144 housing units within the selected census blocks located along the 500 foot wide stream buffer downstream of Brainerd Lake Dam.

Table 7.3.6-2
Population and Housing Units for Selected Census Blocks Intersecting the 500 Foot Wide Stream Buffer Downstream of Brainerd Lake Dam
(Source: US Census Bureau – 2000 Population)

Map ID	Block Number	Population	Housing Units
1	5001	170	75
2	5003	47	21
3	5006	35	17
4	5009	24	11
5	5007	69	20
Total	**----**	**345**	**144**

Table 7.3.6-3 identifies the number of acres within each of the five census blocks for the four land use categories identified on the Brainerd Lake Dam map (Figure 7.3.6-1). The table shows that the "other" land use category has the highest acreage within the selected census blocks. The "other" category combines land uses such as marshlands, recreational areas and forested lands which are probably unpopulated. The residential category is ranked after the "other" category in total number of acres and includes a total population of 345 residents and 144 housing units.

Table 7.3.6-3
Land Use / Land Cover (in acres) for Selected Census Blocks Intersecting the 500 Foot Wide Stream Buffer Downstream of Brainerd Lake Dam
(Source: NJDEP – Land Use Land Cover)

Map ID	Block Number	Commercial (Acres)	Industrial (Acres)	Other (Acres)	Residential (Acres)	Grand Total
1	5001	15.05	1.53	127.42	26.58	170.57
2	5003	5.14	0	14.11	15.89	35.14
3	5006	0	0	6.13	24.14	30.27
4	5009	0	0	547.11	16.75	563.86
5	5007	0	0	487.71	57.16	544.87
Total	**-----**	**20.19**	**1.53**	**1,182.48**	**140.51**	**1,344.70**

Figure 7.3.6-2 is map of Green Street Dam located along the Rahway River in Woodbridge Township. The map identifies the land use / land cover for the census blocks intersecting a 500 foot wide stream buffer.

Figure 7.3.6-2
Green Street Dam
Land Use / Land Cover for Census Blocks Intersecting a 500 Foot-Wide Buffer
(Source: NJDEP)

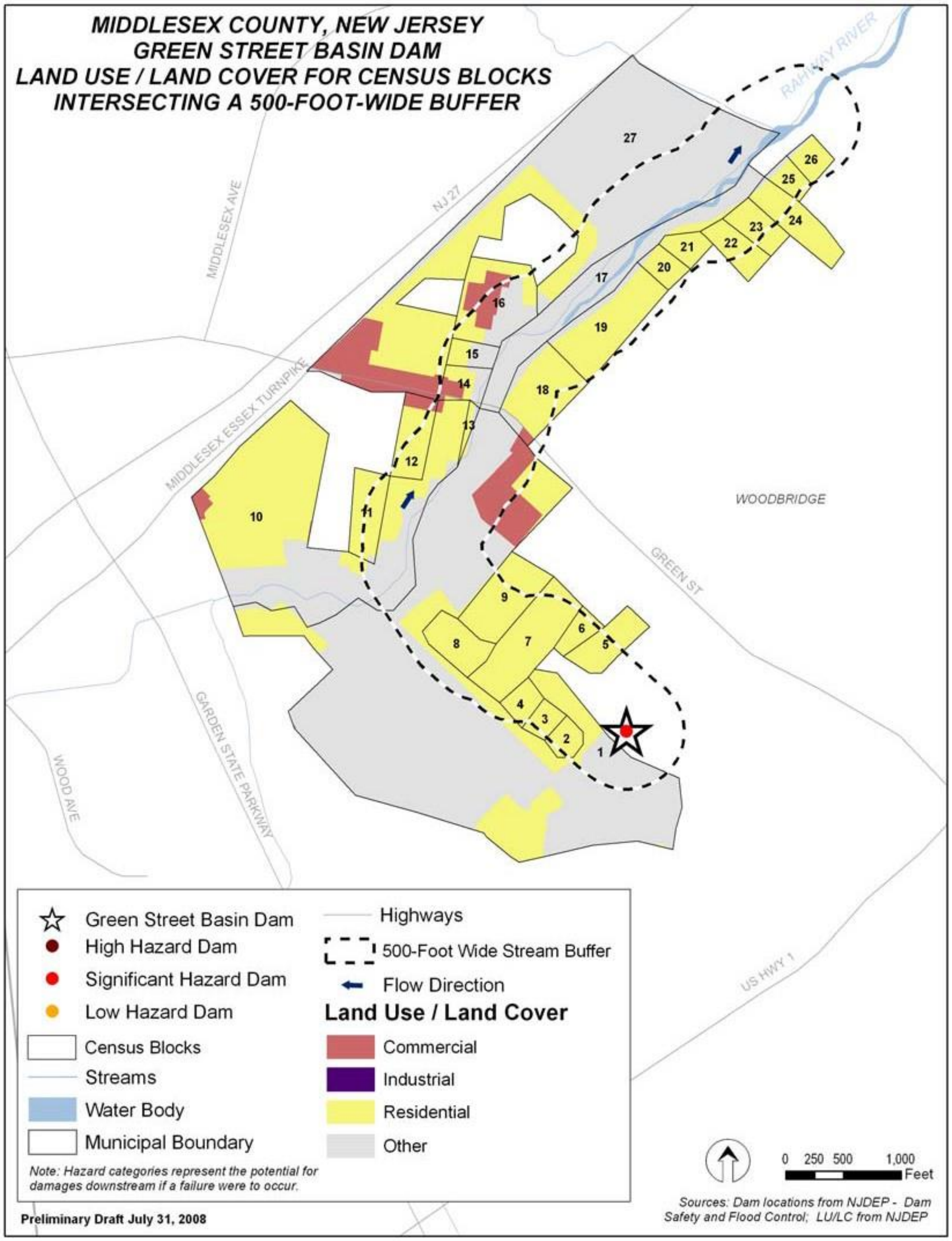


Table 7.3.6-4 identifies the population and housing units for each of the 27 census blocks included on the Green Street Dam map located in Woodbridge Township (Figure 7.3.6-2). There are a total of 2,318 residents and 857 housing units within the selected census blocks located along the 500 foot wide stream buffer downstream of Green Street Dam.

Table 7.3.6-4
Population and Housing Units for Selected Census Blocks Intersecting the 500 Foot Wide Stream Buffer Downstream of Green Street Dam
(Source: US Census Bureau – 2000 Population)

Map ID	Block Number	Population	Housing Units
1	2003	396	164
2	3009	34	10
3	3008	31	10
4	3007	29	10
5	3011	57	18
6	3010	25	10
7	3005	96	35
8	3006	51	14
9	3004	72	22
10	1001	605	227
11	1007	78	27
12	1009	82	30
13	1000	0	0
14	5011	12	7
15	5009	9	2
16	5007	38	16
17	5010	25	6
18	4004	31	14
19	4003	112	43
20	6010	21	7
21	6009	29	8
22	6008	52	20
23	6007	27	14
24	6006	78	26
25	6005	15	6
26	6004	18	7
27	5003	295	104
Total	----	**2,318**	**857**

Table 7.3.6-5 identifies the number of acres within each of the 27 census blocks for the three land use categories identified on the Green Street Dam map (Figure 7.3.6-2). The table shows that the "other" land use category has the highest acreage within the selected census blocks. The "other" category combines land uses such as marshlands, recreational areas and forested lands which are probably unpopulated. The residential category is ranked slightly below the "other" category in total number of acres and includes a total population of 2,318 residents and 857 housing units.

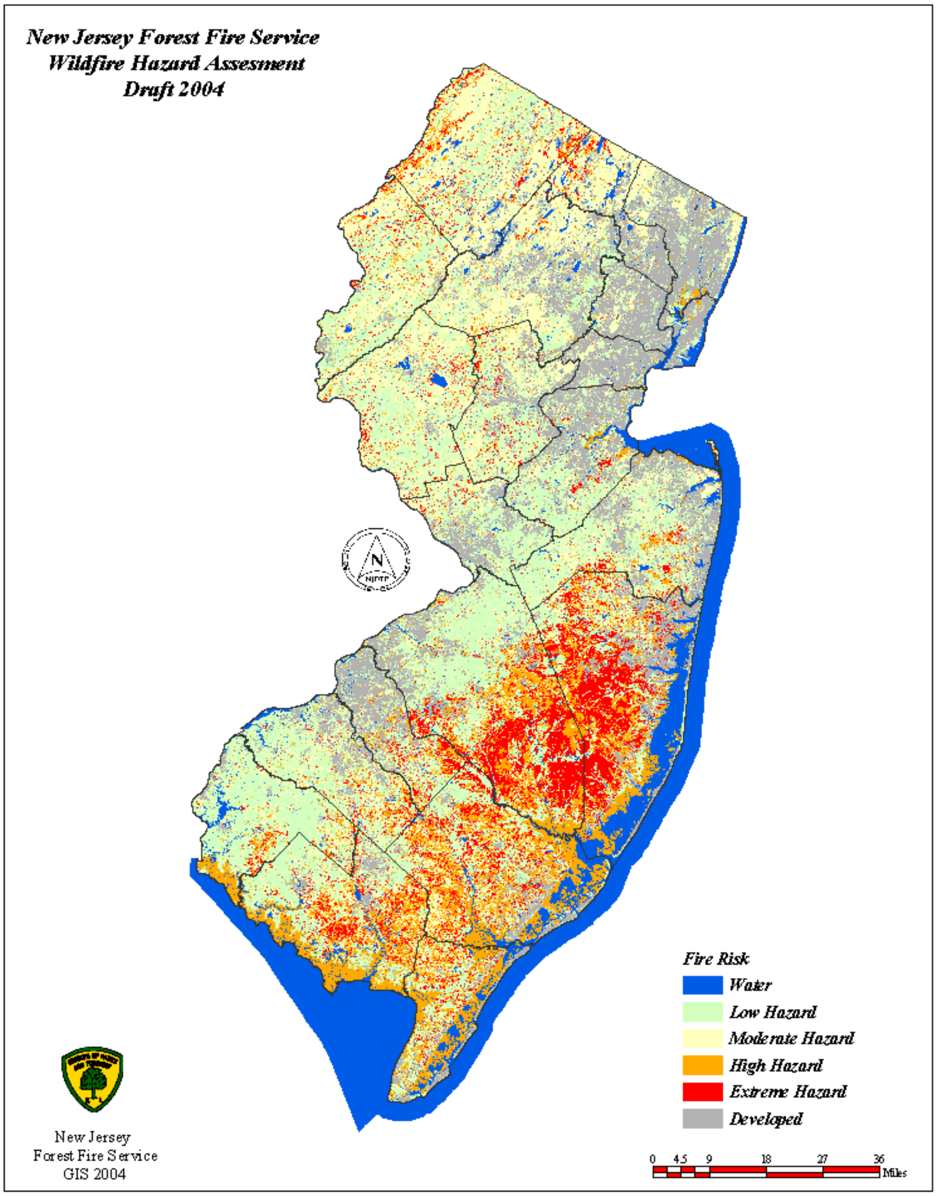
Table 7.3.6-5
Land Use / Land Cover (in acres) for Selected Census Blocks Intersecting the 500 Foot Wide Stream Buffer Downstream of Green Street Dam
(Source: NJDEP – Land Use Land Cover)

Map ID	Block Number	Commercial (Acres)	Other (Acres)	Residential (Acres)	Grand Total
1	2003	6.40	96.28	22.57	125.25
2	3009	0	0	1.78	1.78
3	3008	0	0	1.63	1.63
4	3007	0	0	1.93	1.93
5	3011	0	0	4.31	4.31
6	3010	0	0	1.88	1.88
7	3005	0	0	9.82	9.82
8	3006	0	0	4.23	4.23
9	3004	0	0.00	7.29	7.29
10	1001	0.81	18.90	31.78	51.49
11	1007	0	0.08	4.64	4.73
12	1009	0.74	0	3.96	4.70
13	1000	0	0.16	0.49	0.65
14	5011	0.70	0.93	1.10	2.73
15	5009	0	1.14	0.91	2.05
16	5007	2.71	3.17	3.95	9.84
17	5010	0	14.28	0.78	15.06
18	4004	0.26	1.09	7.03	8.38
19	4003	0	1.24	8.74	9.98
20	6010	0	0.14	1.93	2.07
21	6009	0	0.00	2.01	2.01
22	6008	0	0	3.24	3.24
23	6007	0	0	3.09	3.09
24	6006	0	0.12	5.22	5.34
25	6005	0	0.25	1.57	1.82
26	6004	0	0.15	1.94	2.09
27	5003	7.29	47.37	20.23	74.89
Total	**-----**	**18.89**	**185.31**	**158.06**	**362.27**

7.3.7 Wildfire Risk in Middlesex County

Figure 7.3.7-1 shows the wildfire hazard assessment for New Jersey. The map was produced by the New Jersey Forest Fire Service (NJFFS) in 2004. The map reveals that the majority of the extreme wildfire hazard in New Jersey is concentrated near eastern Burlington and Ocean Counties. In Middlesex County the greatest fire risk is located in the central and eastern part of the county. It should be understood that wildfire hazard can change from year to year, depending on meteorological and antecedent conditions, and the risk (i.e. potential losses) related to wildfires may change depending on the level of exposure, e.g., numbers of structures near hazardous areas, etc. The map below represents the most recent available data.

Figure 7.3.7-1
Wildfire Hazard Assessment for New Jersey
(Source: New Jersey Forest Fire Service)



After reviewing the wildfire hazard assessment map for New Jersey the following municipalities were selected to be further analyzed as part of the risk assessment.

- Old Bridge Township
- Sayreville
- East Brunswick
- Spotswood

As described in Section 6, Hazard Identification, Profiling, and Ranking (Section 6.3.18, Wildfire), the NCDC database indicates that there have been seven wildfires in Middlesex County between 2000 and 2007. Of the seven events, four were located in the municipality of Old Bridge Township and one in Sayreville. No events were reported by the NCDC for East Brunswick or Spotswood. Section 6.3.18 also includes historical wildfire incidents from the NJFFS including tables and maps showing the number of fire incidents in New Jersey per year and the number of acres burned, for the period from 1996 to 2006.

Of the four municipalities selected for the wildfire risk assessment, information about past wildfire events was only available for Old Bridge Township and Sayreville. Table 7.3.7-1 below summaries the past wildfire events for these municipalities.

Table 7.3.7-1
Wildfire Events-Old Bridge Township and Sayreville, 2000-2007
(Source: NOAA/NCDC Database)

Municipality Name	Date	Location	Acres Burned
Sayreville Old	4/29/2000	unavailable	30
Bridge Township	4/30/2000	unavailable	unknown
Old Bridge Township	4/27/2001	Joseph Court area	80
Old Bridge Township	4/28/2001	Cheesequake State Park	151
Old Bridge Township	4/29/2001	Edge of an old landfill near London Terrace Apartments	9

Sayreville

On April 29th, 2000 a pair of salt marsh fires occurred in Sayreville and Old Bridge Township. The fire in Sayreville burned an estimated 30 acres. The NCDC indicated no injuries or damages occurred as a result of the fire. This is the only event identified for Sayreville in the NCDC database.

Old Bridge Township

The NCDC database indicated there have been four previous wildfire events in Old Bridge Township between 2000 and 2007. The largest of these fires occurred on April 28, 2001 when approximately 151 acres burned within Cheesequake State Park. The wildfire affected areas of the park and adjacent areas within Old Bridge Township. The fire began on Saturday the 28th and burned into Cheesequake State Park. The fire forced the evacuation of 25 homes in Old Bridge Township, closed some roadways and forced the closure and the evacuation of campers within Cheesequake State Park. The park was reopened the next day. The NCDC database reported that siding was singed on several homes. Otherwise, damage was limited to sheds, fences and landscaping.

The fires were allegedly set by juveniles. The unseasonably dry weather during the second half of April and the gusty northwest winds on the 28th helped spread the fire quickly. The other three events in Old Bridge Township occurred during the same weekend as the event on April 28, 2001. The NCDC database reported no property damage, injuries or deaths were reported.

Wildfire Risk for Selected Middlesex County Municipalities

The NCDC database indicates that for the five wildfire events that have occurred in the municipalities of Sayreville and Old Bridge Township there have been minimal past damages and no injuries or deaths. Therefore the risk appears to be relatively low in these municipalities. However, if more specific local risk assessments are required at some point in the future (i.e. as part of the cyclical Hazard Mitigation Plan updates) the following paragraphs characterize the data and actions that may be used for this purpose. It is important to recognize that wildfire risk (like most natural hazards) is a function of both the hazard itself, as well as the potential for people, operations, and the built environment to be damaged by the hazard. Also, as is the case with many hazards, the potential for wildfires is partly the result of natural events such as the weather, so there is usually considerable uncertainly in regard to estimating the probabilities of events occurring. With wildfires, however, there are several other important factors that influence risk, such as:

- Fire detection and suppression capabilities
- Amount and type of fuel load (mainly vegetation) in the subject area
- Topography
- Antecedent conditions (such as dryness)
- Proximity of built assets and people to risky areas
- Nature of the built environment
- Prevailing wind

For the purpose of mitigation planning, risk is defined as expected future damages resulting from the effects of natural hazards. As shown in Tables 6.3.18-2 and 6.3.18-3, Middlesex County regularly experiences wildfires or forest fires, averaging slightly more than 183 acres burned per year between 1996 and 2006. However, there are presently no public records that indicate any significant damages related to wildfires, such as structures burned or casualties. Even if this data were present, it would not be an especially reliable predictor of future events. The bullets below indicate some of the data that will be required to perform a detailed risk assessment for wildfires and/or urban interface fires, should the county choose to do so at a later date.

- Specific history of wildfire events (date, number of acres burned, location, maps, etc.)
- Descriptions of damages to structures
- Descriptions of lost function
- Descriptions of injuries or deaths
- Description of any suppression activities by local communities

In many cases, this information will still not be sufficient to perform a risk assessment because areas will experience very few fires. A more rigorous risk assessment is possible if additional information is collected, although the lack of reliable, site-specific probability data, renders such studies are closer to vulnerability assessments. However, the results can still be used in a mitigation plan as the basis for determining appropriate actions to reduce risk. The following information can be gathered to support detailed risk/vulnerability assessments in specific locations. Some of these data change over time, and it is important to ensure that the most current information is being used when assessing risk or identifying mitigation actions.

- Type and amount of fuel load
- Antecedent conditions
- Proximity of people and built environment to potential burn areas
- Characteristics of structures/infrastructure that may be exposed to fire
- Existing detection and suppression capabilities

7.4 Middlesex County Critical Facilities Risk Assessment

Although not a specific requirement for mitigation plans, risk assessments for critical facilities are an important element in developing and prioritizing mitigation actions. At the time this Plan was drafted and approved by the State of New Jersey and FEMA, there was only a limited amount of information available to complete risk assessments for critical facilities in Middlesex County. This subsection describes the information required to complete risk assessments.

FEMA does not prescribe a definition of critical facilities. Generally speaking, critical facilities are those assets and operations that are essential to a jurisdiction maintaining functionality, especially during and after emergencies or significant natural hazard events. There is a range of facilities that can be categorized as critical, including

- Police and fire facilities
- Emergency operations centers
- Water and wastewater treatment plants
- Shelters
- Hospitals (in particular, trauma centers)
- Communications facilities and infrastructure
- Key infrastructure, such as bridges and roads
- Lifelines, in particular utility lines (water, electricity, gas)

Risk assessments typically contemplate three general categories of potential losses: (1) direct damage to structure and contents; (2) loss of function; and, (3) injuries and deaths. There are well-established procedures for calculating these types of risks as they relate to critical facilities. All of these procedures require information about the facilities to facilitate a vulnerability calculation, and then a risk assessment that quantifies potential future losses. Although it is not necessary to have all of the data points listed below, it is highly recommended that jurisdictions attempt to secure as much of the information as possible so that the risk assessment will fully capture all potential risks. Note that all of this information is used in conjunction with data about natural hazards (probability and severity) to calculate risk; this subsection deals only with information related to the facilities. This is a general list of information that should be gathered – note that not all of these data points apply to all critical facilities. For example, it is not necessary to gather the square footage of a bridge or water line.

- Use of the facility
- Location, in particular with respect to natural hazards, and preferably with latitude/longitude
- Size of the facility (for buildings, in square feet)
- Replacement value of the asset (can usually be obtained through open sources)
- Description and replacement value of contents (can usually be obtained through open sources)
- Structure type (for buildings, preferably in conformance with FEMA HAZUS descriptors)
- Elevation (above mean sea level)
- Occupancy (i.e. number of people, preferably by time of day)
- Annual budget of the operation

- Cost of securing similar alternative facilities (not critical information)
- Volume of service provided (applies to lifelines and transportation infrastructure)
- Number in community served by the facility or operation
- Any history of losses related to natural hazards (direct damages, loss of function)
- Any existing engineering or vulnerability studies
- Photographs of the facilities and surrounding area

The present subsection is not intended to provide an explanation of how to complete a vulnerability or risk assessment. The information listed here is the basic data required to complete a risk assessment. FEMA has an extensive suite of software and guidance that can be used for this purpose, including the 386-series of mitigation planning guides, in particular publication 386-2 *Understanding Your Risks: Identifying Hazards and Estimating Losses* (fema.gov/library, then use search engine). All of the benefit-cost analysis software and technical manuals are also available through FEMA.

The risk assessment is an essential first step in the process of identifying sites where additional study may be warranted and/or where efforts should be focused on developing mitigation actions. After developing a risk profile for a critical facility (i.e. a calculation of expected future losses from various hazards), potential losses can be readily compared to provide a picture of which combinations of vulnerability and hazards appear to be the most significant. Once this is known, there are several potential next steps.

- **No action:** If risks are relatively small in an absolute sense, or in comparison to other facilities, the results of the assessment can be used as a way to assign low priority to any mitigation actions, including additional study and specific projects.
- **Further study:** The risk assessment will show the source of potential future damages and losses, although in some cases not in enough detail to identify specific vulnerabilities. The risk calculation will inform decisions about the need for additional study, which will in turn lead to the development of mitigation actions. Such studies are nearly always completed by engineers or architects, with experience and technical knowledge related to the performance of building and infrastructure components. It is also important to understand the expected performance of any mitigation projects in reducing risk–this should be a part of any vulnerability study. It is also important to understand the costs of any mitigation projects that may be indicated, so that (if a particular project is part of a grant application) its costs can be compared to the risks (and effectiveness–as above) to determine if it merits funding.
- **Develop mitigation alternatives:** In cases in which vulnerabilities are obvious based on the risk assessment and other empirical knowledge of an asset or site (including existing local knowledge or engineering studies), it may be possible for a jurisdiction to bypass any additional vulnerability studies, and proceed to the process of developing mitigation alternatives for high-priority sites. These can partially be identified through the risk assessment process, which quantifies potential damages and allows comparisons. In cases where specific vulnerabilities are well understood, it is possible to develop basic specifications for mitigation projects, then to compare their effectiveness and costs to the results of the risk assessment. This is the most important use of the risk assessment data, outside the process of selecting sites for study.

It is not possible in the context of a hazard mitigation plan to discuss all potential mitigation projects, because there is a very large number of them, and because they have widely varying effectiveness and costs. The risk assessment process is an essential first step in identifying sites that merit additional study, and in making valid comparisons of cost savings among different assets and mitigation projects.

It is important to note that the participating municipalities in Middlesex County have made substantial progress in identifying and gathering information about their critical facilities. Appendix E.2 contains an excerpt of the information that has already been gathered as part of the development of this Plan. This information was important in helping some of the participating municipalities identify candidate mitigation projects in this Plan and it is expected that improving the quality and quantity of data regarding these facilities will result in the identification of additional viable projects as part of subsequent plan updates.

7.5 Middlesex County Future Development Trends

This subsection of the Middlesex County HMP identifies areas in the county that may have potential for development, particularly in floodplains. There is presently no Geographical Information System (GIS) or database that includes county-wide zoning or comprehensive planning information. Because of this, the planning team determined that areas of potential development could be identified by compiling spatial data from several statewide planning-related documents, then using a GIS-based process to remove areas that are either already developed, or are unlikely to be developed because of land use restrictions, especially statewide policies.

The main sources of data for this process were the New Jersey State Development and Redevelopment Plan (NJDRP), the New Jersey Department of Environmental Protection, and the New Jersey Department of Community Affairs - Office of Smart Growth. The planning team secured GIS-based data sets from each of these sources, with the purpose of identifying areas that are appropriate and inappropriate for development, according to various land planning and environmental protection standards.

The NJDRP establishes five *Planning Areas* that are used to apply statewide policies to both natural and built resources. In order to ensure consistency with statewide land planning designations (and because there is presently no statewide land use or zoning database), the Middlesex County Hazard Mitigation Steering Committee (HMSC) determined that these Planning Areas should be used as a general basis for describing existing land uses and identifying areas with potential for development.

There are five Planning Area designations. These five Planning Areas are large masses of land (more than one square mile in extent) that share a common set of conditions such as population density, infrastructure systems, level of development or natural systems. The Planning Areas reflect distinct geographic and economic units within the State and serve as an organizing framework for application of the statewide Policies of the State Plan.

- **Metropolitan Planning Area (Planning Area 1)** provides for much of the State's future redevelopment. Revitalize cities and towns; promote growth in compact forms; stabilize older suburbs; redesign areas of sprawl; and protect the character of existing stable communities.
- **Suburban Planning Area (Planning Area 2)** provides for much of the state's future development. Promote growth in Centers and other compact forms; protect the character of existing stable communities; protect natural resources; redesign areas of sprawl; reverse the current trend toward further sprawl; and revitalize cities and towns.
- **Fringe Planning Area (Planning Area 3)** accommodate growth in Centers; protect the Environs primarily as open lands; revitalize cities and towns; protect the character of existing stable communities; protect natural resources; provide a buffer between more developed Metropolitan and Suburban Planning Areas and less developed Rural and Environmentally Sensitive Planning Areas; and confine programmed sewers and public water services to Centers.
- **Rural Planning Area and Rural/Environmentally Sensitive Planning Area (Planning Area 4)** maintain the environs as large contiguous areas of farmland and other lands; revitalize cities and towns;

accommodate growth in Centers; promote a viable agricultural industry; protect the character of existing stable communities; and confine programmed sewers and public water services to Centers.

- **Environmentally Sensitive Planning Area and Environmentally Sensitive/Barrier Islands Planning Area (Planning Area 5)** protect environmental resources through the protection of large contiguous areas of land; accommodate growth in Centers; protect the character of existing stable communities; confine programmed sewers and public water services to Centers; and revitalize cities and towns.[6]

The State Development and Redevelopment Plan (NJDRP) indicates that Planning Area designations 1 and 2 are most appropriate for development, although in some limited circumstances the other areas may also be considered appropriate. This section of the County hazard mitigation plan does not include a detailed discussion of the criteria used in the NJDRP, but planners and local officials can review the latter plan on the web at http://www.state.nj.us/dca/osg/plan/.

The NJDRP is supported by the identification of Smart Growth areas. Smart Growth is the term used to describe well-planned, well-managed growth that adds new homes and creates new jobs, while preserving open space, farmland, and environmental resources. Smart Growth supports livable neighborhoods with a variety of housing types, price ranges and multi-modal forms of transportation. The Smart Growth Areas were created to help implement the goals of the New Jersey State Plan (Source: NJ Department of Community Affairs - Office of Smart Growth).

The boundaries of the smart growth areas in New Jersey were developed by the Office Smart Growth. The Smart Growth areas supporting the NJDRP are predominately located within the Metropolitan Planning Area and Suburban Planning Area, but also include land within the growth areas of the NJ Pinelands Management Areas as well as some areas of the Meadowlands.

Figure 7.5-1 highlights in tan the remaining buildable land within the Smart Growth areas for Middlesex County. Also identified on the map are the FEMA designated 100-year and 500-year floodplains. The five Planning Areas from the NJDRP and the Smart Growth areas described above were used to isolate the buildable lands. To identify the remaining buildable lands in Middlesex County, the areas designated as non-Smart Growth and the Planning Areas not suitable for development were eliminated as buildable land. In addition, areas already considered urban were also eliminated. The area remaining is considered the buildable land area identified on the Middlesex County Future Growth Map.

[6] 2001 State Development and Redevelopment Plan

Figure 7.5-1
Middlesex County Future Growth Locations
(Sources: 2001 New Jersey State Development and Redevelopment Plan, FEMA, NJDEP)

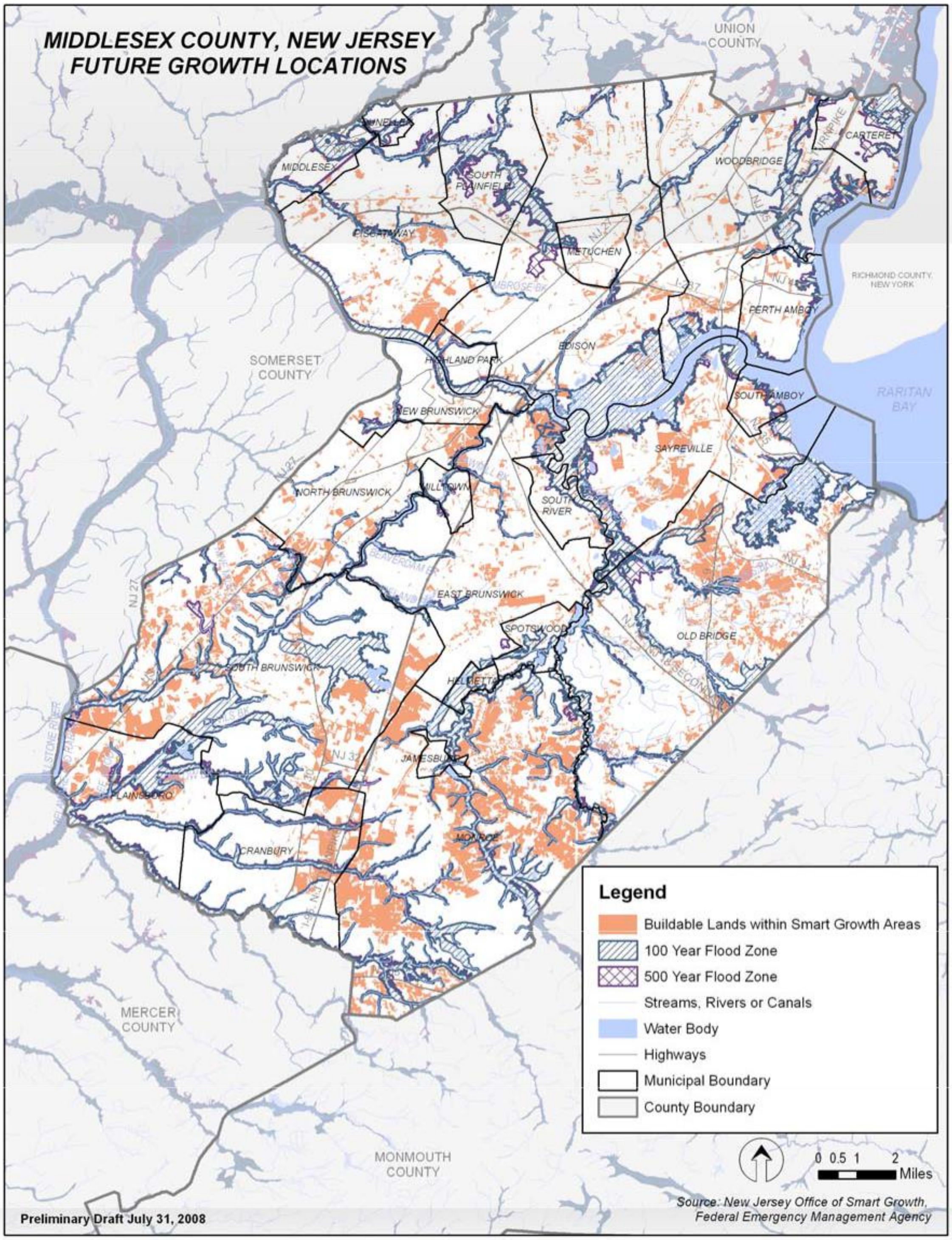


Table 7.5-1 identifies the acres of remaining buildable land areas in Middlesex County that are displayed above on the Future Growth Locations map. The data is ranked by the total number of buildable acres in each municipality and is broken out by FEMA flood zones (100 and 500-year floodplain). The table reveals the majority of buildable land area in Middlesex County is located outside of the 100-year and 500-year floodplains. Within Middlesex County, the largest area of buildable land is located in Monroe Township.

Table 7.5-1:
Middlesex County Buildable Land (in acres) by Flood Zone, Ranked by Municipality
(Sources: 2001 New Jersey State Development and Redevelopment Plan, FEMA)

Municipality Name	Acres within 100-year Floodplain	Acres within 500-year Floodplain	Acres Outside 500-year Floodplain	Grand Total
Monroe Township	338	43	7,864	8,245
South Brunswick Township	258	57	4,524	4,839
Old Bridge Township	197	31	3,637	3,865
Sayreville Borough	171	69	1,724	1,964
Edison Township	161	21	1,501	1,683
Piscataway Township	44	25	1,549	1,617
East Brunswick Township	209	33	1,361	1,604
Woodbridge Township	289	50	1,262	1,601
Cranbury Township	56	56	1,067	1,179
North Brunswick Township	31	6	1,129	1,167
Plainsboro Township	65	56	937	1,058
New Brunswick City	47	15	275	337
Perth Amboy City	10	4	245	259
Carteret Borough	73	44	115	233
South Amboy City	29	17	176	222
South Plainfield Borough	30	12	167	209
South River Borough	28	3	137	168
Metuchen Borough	4	4	144	153
Highland Park Borough	12	18	115	145
Spotswood Borough	24	1	111	136
Middlesex Borough	31	12	65	108
Helmetta Borough	13	1	53	67
Milltown Borough	16	4	45	65
Jamesburg Borough	7	1	38	45
Dunellen Borough	4	1	3	8
Total	**2,148**	**585**	**28,245**	**30,978**

7.6 Summary of Risk Assessment

Mitigation planning is intended to provide a rational method for communities to decide what actions to take to reduce their risks from natural hazards. Aside from actually determining and implementing specific actions, perhaps the most important part of a mitigation plan is the risk assessment, which establishes an objective basis for prioritizing mitigation efforts. The risk assessment in this plan was used to develop a sense of where the most significant risks are in Middlesex County, to identify the hazards that present the most potential damage to the county, municipalities and their assets, to ascertain where additional study may be warranted, and to begin the process of identifying and prioritizing mitigation actions.

Section 6 of this plan describes the location, extent and effects of past events, and discusses the probabilities of the various hazards affecting the county in the future. For some hazards there is a large body of information available to support detailed examinations, while some others are less potentially significant, and therefore not studied as much. Table 7.6-1 summarizes the risk (future loss) estimates for floods, high winds, winter storms, earthquakes and hazardous materials releases. The figures are based on calculations of direct damages, losses of functions and casualties. Middlesex County shows a fairly typical pattern, i.e. that flood is by far the most significant threat when analyzed on a site-specific basis (see right-hand columns of Table 7.6-1), although the data shows lower total risk from floods than from the other hazards when considered across the entire county and over a long planning horizon.
The reason for this is that the flood hazard is relatively concentrated in a geographic sense, while the entire County is uniformly exposed to the effects of wind, winter storms and earthquakes (although there are some variations from place to place, based on topography, soils, etc., which are discussed in the present section, as well as in Section 6 of this plan).

Table 7.6-1:
Summary of Middlesex County Natural Hazard Risks
by Asset and Hazard Type (100-year horizon)
(Sources: 2000 US Census, HAZUS)

Hazard	Asset	Risk (100-year horizon)	Risk Per SF (1)	Risk Per Capita (2)
Flood	Repetitive loss properties (residential)	$7,758,185	$20.30	$16,248
Flood	Severe Repetitive loss properties	$356,366	$29.69	$23,757
Flood	Deaths and Injuries	Not Determined	NA	NA
High Wind - Straight-line Winds	All Assets	$677,027,821	$1.81	$462
High Wind - Straight-line Winds	Deaths and Injuries	Not Determined	NA	NA
Severe Storm - Winter Weather	All assets, direct damages (3)	$20,856,147	NA	$14
Severe Storm - Winter Weather	Deaths (monetized) (4)	$3,253,560	NA	NA
Severe Storm - Winter Weather	Injuries (monetized)	$856,200	NA	NA
Earthquake / Geological	All Assets	$79,530,640	$0.21	$54
Earthquake / Geological	Deaths (monetized)	$140,452,376	NA	NA
Earthquake / Geological	Injuries (monetized)	3,726,107	NA	NA
Hazardous Materials Release (fixed sites and transportation)	All assets, direct damages	See Section 7.3.5	NA	NA
Dam Failure	All assets, direct damages	See Section 7.3.6	NA	NA

Notes: (1) Risk per square foot (SF) estimate for the flood hazard based on average building size of 2,000 SF. Risk per SF for the high wind - straight-line wind and earthquake (Geological) hazards based on HAZUS estimate of total square footage for the County (See Table 7.3.2-6). (2) Risk Per Capita column based on Middlesex County 2000 population from the US Census Bureau. Flood risk per capita based on household occupancy of 2.5 people per dwelling. (3) Winter storm risks are assumed to be primarily related to damages to public assets and infrastructure, to interrupted services, or to response requirements. (4) Standard FEMA practice is to express deaths and injuries in terms of dollars (monetized) in order that the risks can be compared to other categories that are not related to life safety. For further information see FEMA Guidance titled *What is a Benefit*? (included on BCA Toolkit version 3.0).

As noted earlier, the purpose of risk assessment is to identify and quantify future losses from natural hazards, with the goal of using this information to determine what actions should be taken to reduce damages. Although Middlesex County as a whole has more risk from wind, winter storms and earthquakes than it does from floods, there are several factors that must be considered and understood in this context. First, as noted, wind, winter storm and earthquake hazards are far less site-specific than floods and most other natural hazards, so the risk is by definition greater because the whole County is exposed. However, it must also be understood that there are no large-scale mitigation measures that will reduce risks to all properties simultaneously, so site-specific risks are a more significant consideration than County-wide ones in most cases. It is necessary to calculate risks on a site-specific basis as a first step in developing meaningful mitigation actions. The paragraphs below describe initial steps that the County and municipalities can take to begin a more detailed risk assessment process that will inform the process of developing mitigation actions.

Flood

There is already a range of more specific information in this section related to the flood hazard in Middlesex County, and this has been used to identify sites to study in more detail. Specific sites have also been identified for further study, based in part on the estimates in this section. Table 7.3.1-4 through 7.3.1-6 provides key flood risk metrics that have been used to prioritize these areas. For example, Table 7.3.1-4 shows the various municipalities in the County with repetitive flood insurance claims. . In some municipalities (such as the Townships of Piscataway and Woodbridge) there are a relatively high average number of claims per policy, and a high average claim value. This suggests that there is significant flood risk in these areas.

Although this is not definitive, it does offer some insight to where planners and engineers should focus efforts to more fully determine flood risk. Similarly, Table 7.3.1-5 shows specific streets in the municipalities that include non-residential flood insurance claims. In Middlesex County, Kelsey Avenue in the City of Perth Amboy, and Jersey Avenue in the City of New Brunswick have the highest number of claims in the data set, and relatively high average claims values. Table 7.3.1-6 shows individual streets in the various municipalities, with numbers of claims and average amounts of claims. The data can be used in the same manner as described above. For example, in this table Raritan Avenue and Bound Brook Road in Middlesex Borough have relatively high numbers of claims (and high average numbers of claims per property), and high average claims amounts. It is also important to recognize that in some cases (particularly for flood mitigation), it may be possible to develop mitigation measures that address risks to multiple properties. Because of this it is important to develop an understanding of the proximity of flood-prone structures to each other, and of the local topography and hydrologic conditions that may influence risk.

High Wind—Straight-line Wind

Straight-line wind risk is addressed in detail in Subsection 7.3.2. As noted, the wind risk can be considered fairly uniform across Middlesex County, although topography and vegetation can influence the effects of the hazard to some degree. Subsection 7.3.2 addresses a range of building types, based on best available asset inventory information from open sources. While this is a reasonable approach to large-scale assessments such as this, there are many characteristics of individual buildings that must be considered in a site-specific risk assessment. These include the amount of exterior glazing (and structural characteristics of the glazing), roof configuration, ground-to-roof structural characteristics (load path), and the strength and configuration of doors. Although some site characteristics can influence the severity of the wind hazard (by increasing or reducing velocity, or by the presence of potential windborne missiles), most wind risk is related to built assets. Because of this, the process of identifying and prioritizing sites for further study is simpler than it is for earthquakes.

This Plan recommends that Middlesex County undertake more detailed wind risk assessments, based on identifying the most critical facilities and compiling specific structural data about them. In 2006 FEMA developed a wind hazard database that is used in conjunction with the Agency's benefit-cost analysis software. The database includes a list of several dozen structural types, and associated wind damage functions. This list of structure types can be used as the basis for field work to collect information about critical facilities and other buildings. It should be noted that most of New Jersey (including Middlesex County), has a relatively low level of wind hazard, so the County should probably start with a fairly small list of its most critical facilities and operations, and estimate the risks for those, before continuing with any additional work on assets that are less important.

Earthquake/Geological

As described in Subsection 7.3.4, there is a moderate degree of earthquake risk in Middlesex County. However, the risk study done in support of this plan is not highly detailed, especially as regards site-specific elements such as soil characteristics and building structural types. As described in Section 9 (Mitigation Strategy), it will be desirable for Middlesex County to identify and prioritize specific areas or facilities where there is a high density of built assets and populations. In these areas (and potentially others), this Plan also recommends that the County undertake a more detailed examination of proximity to faults and soil characteristics, to further identify areas that may be at higher risk because of the hazard (as opposed to the nature of the built environment or presence of populations). The purpose of these exercises is to identify combinations of hazard, population and building characteristics that suggest elevated risk. Some building types – specifically unreinforced masonry, which is common in New Jersey - are particularly prone to damage and collapse when subjected to shaking forces, and should be studied from an engineering perspective when they are in areas subject to soil liquefaction, particularly when the facilities house critical operations or have large occupancies.

Other Countywide Hazards

With regard to the other hazards shown in the table above (severe storm - winter weather, hazardous materials releases and dam failures), there is presently not enough open-source information to support specific conclusions about risks, or to make meaningful comparisons to other hazards.

In the case of severe storms - winter weather, the risk is presumably widespread, and related to vulnerabilities in buildings (and infrastructure) as well as to deaths and injuries, and the costs of snow and ice mitigation. There are several specific actions that the County or individual jurisdictions can undertake to better understand winter weather risks. A typical approach is to identify and prioritize critical facilities, then undertake engineering studies of the facilities to identify any hazard-specific vulnerabilities such as weak structural systems, or exterior infrastructure (such as electrical feeds or antennae) that may be subject to damage from snow/ice loads or high winds.

Risk assessments for hazardous materials releases are a complex undertaking for several reasons, including the fact that they are generally non-probabilistic (meaning that the likelihood of occurrence cannot usually be determined based on past history or specific studies, except in the most general sense), and there is a very large range of materials that fall into this category, with widely differing characteristics, including toxicity, means of potential dispersion, half-life, and so forth. New Jersey has a very well-established system for cataloging and controlling hazardous materials, though for security reasons much of the information related to the subject is confidential. Because of this, the scope and conclusions of a hazardous materials risk assessment are necessarily limited in a mitigation plan; the information included in this document can be used to provide context to exposure and vulnerabilities in the County, but detailed comparative risk assessments are in the purview of experts at the federal, State and local levels. As noted in the related subsections above, hazardous materials information is constantly changing, so it is advisable to periodically update the specific metrics that are included in the sections, for example: releases, the amounts of materials stored and handled at specific sites, and the amounts and types of materials that are transported.

In the State of New Jersey, the Department of Environmental Protection maintains an inventory of dams, including hazard rankings, as discussed in detail in the subsection above. Although the rankings offer a good initial indication of which dams may create risks (particularly in conjunction with the downstream buffer methodology used in this section), there are numerous risk variables that should be studied if a comprehensive, engineering-based assessment is needed. As noted, these variables include the condition of the dam(s), the amount of water impounded behind them, local topography, and downstream populations and infrastructure. As is the case with other hazards discussed here, if a more detailed risk assessment is needed, the County could prioritize the dams based on the variables noted above, then identify a means to complete an engineering study, perhaps in cooperation with NJDEP.

Section 9 of this Plan outlines a series of general recommendations that can be implemented on a county-wide basis as well as a wide range of specific, prioritized actions that individual municipalities are committing to as part of the planning process. The HMSC and Local Coordinators used the present risk assessment section as the basis for these actions and priorities. However, it has been generally acknowledged that additional information would be helpful in refining and updating this Plan in the years to come. Section 9 also includes actions to aid in this process that include the following general steps:

- Continue to identify and prioritize critical facilities, facilities with high occupancies, or operations with high value
- Study hazard vulnerabilities based on specific conditions and hazards at sites for the highest priority sites and facilities
- Undertake detailed risk assessments for critical facilities in hazard areas, and with known vulnerabilities
- Develop appropriate, cost-effective mitigation measures for the facilities

Relative Risks in the Municipalities

Table 7.6-2 provides a general comparison of hazard vulnerabilities among Middlesex County jurisdictions. All hazards included in the present risk assessment section of the plan are included in the matrix, although only four of the seven hazards include rankings in the matrix below because there was no jurisdiction-level risk or vulnerability data available at the time this Plan was completed. For the flood, high wind, winter storm and dam failure hazards, the risk in each jurisdiction is ranked high, medium or low. These relative rankings are based on a composite review of the risk data presented earlier in this section, and are intended *only* as a relative indication of potential risks. It should be understood that even where overall risks are ranked medium or low, in many cases specific sites, populations and operations in communities may still be at elevated risk from certain hazards.
The matrix is intended only as a general indication of where County of local planners may wish to focus their initial attention in further understanding risks and the potential for mitigation actions if resources are limited.

The flood rankings were generally based on (1) the numbers of National Flood Insurance Program claims in the various communities (and the amounts of the claims, and (2) the percentage of the jurisdiction in the floodplain. The high wind and winter storm rankings are based on the potential dollar losses described in Subsections 7.3.2 and 7.3.3, respectively.

Table 7.6-2
Middlesex County Municipality-Level Risk Matrix

Municipality Name	Flood	High Wind	Winter Storm	Earthquake/ Geological	Dam Failure	Levee Failure	Wildfire
Carteret Borough	L	L	L	Note 1	L	Note 2	Note 3
Cranbury Township	L	L	L	Note 1	M	Note 2	Note 3
Dunellen Borough	M	L	L	Note 1	L	Note 2	Note 3
East Brunswick Township	L	M	L	Note 1	L	Note 2	Note 3
Edison Township	L	H	L	Note 1	L	Note 2	Note 3
Helmetta Borough	M	L	M	Note 1	L	Note 2	Note 3
Highland Park Borough	L	L	L	Note 1	L	Note 2	Note 3
Jamesburg Borough	L	L	L	Note 1	L	Note 2	Note 3
Metuchen Borough	L	L	L	Note 1	L	Note 2	Note 3
Middlesex Borough	H	L	M	Note 1	L	Note 2	Note 3
Milltown Borough	L	L	L	Note 1	L	Note 2	Note 3
Monroe Township	L	M	L	Note 1	L	Note 2	Note 3
New Brunswick City	L	L	L	Note 1	L	Note 2	Note 3
North Brunswick Township	L	M	L	Note 1	L	Note 2	Note 3
Old Bridge Township	L	M	L	Note 1	L	Note 2	Note 3
Perth Amboy City	L	M	L	Note 1	L	Note 2	Note 3
Piscataway Township	L	M	L	Note 1	L	Note 2	Note 3
Plainsboro Township	L	L	L	Note 1	L	Note 2	Note 3
Sayreville Borough	L	M	L	Note 1	L	Note 2	Note 3
South Amboy City	L	L	L	Note 1	L	Note 2	Note 3
South Brunswick Township	L	M	L	Note 1	L	Note 2	Note 3
South Plainfield Borough	M	M	L	Note 1	L	Note 2	Note 3
South River Borough	M	L	L	Note 1	L	Note 2	Note 3
Spotswood Borough	L	L	L	Note 1	L	Note 2	Note 3
Woodbridge Township	M	H	M	Note 1	M	Note 2	Note 3

Note 1 – In some cases there may be moderate earthquake or landslide risk in certain jurisdictions, but the availability of technical data does not support such determinations on a local level at this time. As noted earlier in Subsection 7.3.4, earthquake risk in particular is a function of both the seismic hazard and the nature of the built environment (specifically, the tendency of structures to fail under shaking loads). Earthquake (and landslide) risk assessments must be conducted on a highly site-specific basis.

Note 2 – As noted earlier in the risk assessment subsection, there is presently very little information available about the potential for levee failures, even on a County level, and as such the risk cannot be ranked.

Note 3 – Wildfire records in New Jersey are compiled on a County level, and therefore it is not possible to rank the risk at the jurisdiction.

County and Municipal Mitigation Actions

The following are examples of mitigation actions included in the Section 9 as part of the Mitigation Action Plan that are intended to mitigate hazards included in the detailed risk assessment as well as all hazards identified in Section 6 as relevant for Middlesex County.

Dam Failure

- The analysis in Section 7.3.6 indicate that as many as four different municipalities could be impacted by failure of the two NJDEP-designated high hazard dams that was analyzed as part of the Plan. The municipalities did not identify specific mitigation actions in this plan due to the complexity of the issues involved and the lack of clear mitigation action alternatives. Instead, Middlesex County Action Items 2.A.18 and 2.A.19 were included for follow-up investigations and actions by MCOEM with NJDEP.
- In addition, Middlesex County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include dam failure.

Earthquake/Geological

- The analysis in Section 6.3.3 and Section 7.3.4 indicates a relatively low magnitude and intensity for past events. Middlesex County has experienced few minor earthquakes on average over the past 75-plus years. Therefore, no specific mitigation actions were identified in this Plan at the municipal level due to the low risk and the need to verify site-specific conditions and vulnerabilities as well as the lack of specific mitigation action alternatives. Instead, Middlesex County Action Items 2.A.6, 2.A.7, 2.A.8 and 2.A.9 were included for follow-up investigations and actions by MCOEM with the New Jersey Geological Survey (NJGS).
- In addition, Middlesex County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include earthquake and other geological hazards.

Erosion

- Middlesex County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include erosion.
- In addition, Middlesex County Action Item 2.A.10, as well as the following representative example of municipal action items were included in Section 9 to include erosion:
    - Jamesburg Borough 1

Flood

- The analysis in Section 7.3.1 indicates that floods have been and continue to be the most frequent, destructive, and costly natural hazard facing Middlesex County. Repetitive losses properties have been designated in a number of municipalities and are most prevalent in the Middlesex Borough, South Plainfield Borough, and Dunellen Borough. Repetitive loss properties have been addressed in Section 9 – Mitigation Strategy in all indicated communities as follows:
    - Cranbury Township #2.
    - Dunellen Borough #4.
    - East Brunswick #5.

    - Middlesex Borough #1
    - Monroe Township #3
    - Old Bridge Township #1
    - Sayreville #3
    - South Plainfield Borough #1
    - South River Borough #1.
- In addition, the following county and municipal actions for other flooding problems have been developed in response to the results of Section 7.3.1:
    - Middlesex County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include flood.
    - Middlesex County Action Item 3.A.1 and other county-level mitigation actions address issues related to repetitive flood losses in the county and participation in the NFIP and/or CRS.
    - South Brunswick Township 1 is one example of several municipal level action items included that specifically address flood risk.

High Wind – Straight-Line

- Middlesex County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include straight-line high winds.
- In addition, the following representative examples of municipal action items were included in Section 9 to include straight-line high winds:
    - Dunellen Borough 1
    - East Brunswick Township 2
    - Edison Township 4
    - Old Bridge Township 4
    - Perth Amboy City 1
    - South Plainfield Borough 2
    - Woodbridge Township 14

High Wind – Tornado

- Middlesex County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include tornados.

Severe Weather – Winter

- Middlesex County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include severe winter weather.
- In addition, Middlesex County Action Items 2.A.8 and 2.A.15 address severe winter weather:

Storm Surge

- Middlesex County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include storm surge
- In addition, Middlesex County Action Items 2.A.16, and 2.A.17 as well as the following representative examples of municipal action items were included in Section 9 to include storm surge:
  - Carteret Borough 2
  - Old Bridge Township 7
  - Perth Amboy City 2
  - Sayreville Borough 7
  - South Amboy City 2
  - Woodbridge Township 15

Wildfire

- As noted in Section 7.3.7, wildfire was not identified as a hazard of concern on a county-wide basis. However, three municipalities identified specific concerns and developed action items as follows:
  - East Brunswick Township 6
  - Old Bridge Township 5
  - Perth Amboy City 2
  - Sayreville Borough7
  - South Amboy 2
  - Spotswood 2
  - Woodbridge Township 15
- In addition, Middlesex County Action Items 2.A.7, and 2.A.9 address wildfire from a county-wide perspective and Middlesex County Action Item 1.A.1 and related actions items for all municipalities regarding developing an all-hazards public education and outreach program for hazard mitigation and preparedness will include wildfire.

Section 8
Capability Assessment

Contents of this Section

8.1 Overview and Purpose of Capability Assessment

Although not required by DMA 2000 or the Interim Final Rule, a capability assessment adds context to a mitigation plan by providing an inventory of a jurisdiction's programs and policies, and an analysis of its capacity to carry them out. These are essential for developing mitigation strategies and actions.

The capability assessment is a review of Middlesex County's resources in order to identify, review, and analyze what the county is currently doing to reduce losses, and to identify the framework that is in place for the implementation of new mitigation activities. A helpful component is to understand coordination efforts with the New Jersey State Office of Emergency Management (NJOEM) and federal agencies and resources. In addition, this assessment will be useful in gauging whether the current local organizational structures and inter-jurisdictional or county coordination mechanisms for hazard mitigation could be improved, and how.

This local capability is extremely important, because the municipal officials know their own landscape best. Additionally, many of the most critical and effective hazard mitigation strategies and programs, including enforcement of floodplain management, building codes, and land-use planning, require a strong local role to achieve effective implementation.

New Jersey follows a strong "Home Rule" legal philosophy. That philosophy dictates that all land in the state not directly belonging to a government entity is incorporated into a municipality, and that each municipality must assign an individual to be responsible for its local emergency management duties; that person is responsible for coordinating municipal emergency response with county, state and federal officials.

8.2 Methodology

This capability assessment results from research, interviews, and surveys. Relevant documents were reviewed related to hazard mitigation, including especially the New Jersey State Hazard Mitigation Plan Update (2008), as well as state and federal sources related to funding, planning, and regulatory capability. Extensive summary information from these sources can be found in Appendix F1-F.3.

For the county capability assessment, a series of in-depth one-on-one interviews provided key insights and information. In Middlesex County, these interviews were conducted during the month of July 2008 with the following individuals:

- John Ferguson, Deputy Emergency Management Coordinator, County Office of Emergency Management
- Jane Leal, Director of Administration, County Improvement Authority
- George Ververides, Director of County Planning, County Planning Board
- Ralph Albiner, Director, County Parks and Recreation Department
- Joe Valdes, Supervising Engineer, County Engineering Department

For the municipal capability assessment, a web-based survey tool was designed and administered. The questions were vetted by the Middlesex County Office of Emergency Management (MC OEM), and the survey was live from April 30, 2008 until June 30, 2008. The survey was targeted to the primary municipal contacts for this planning process. For the most part, these are municipal Office of Emergency Management (OEM) coordinators. Other municipal staffs with relevant expertise – including those in the departments of planning, public works, and buildings – were encouraged to take the survey as well.

The survey generally covered the following topics:

- Staff, personnel, and technical capability
- Knowledge of FEMA mitigation programs
- Current/ongoing mitigation efforts
- Intra- and inter-governmental coordination
- Land use and regulation
- Floodplain management
- Building code inspection
- Capital improvement
- Land conservation programs

The text of this survey, as well as tabular results and the results of each respondent can be found in Appendix F.4.

Additionally, a separate survey was created to assess the knowledge of the general public in matters related to hazard mitigation. This is a key capability issue, as many of the most crucial mitigation decisions are made by members of the public. The questions were vetted by the MC OEM, and the survey was posted on the Middlesex County website. To date, the survey has not yet generated sufficient responses to draw meaningful results, but in the future such an analysis can be performed. The text of this survey can be found in Appendix F.4

8.3 Federal and State Regulations, Plans, and Funding Sources

8.3.1 Inventory of Regulations, Plans and Funding Sources

This section, including Table 8.3.1-1, provides summary information regarding selected federal and state regulations, plans, and sources of funding that are relevant to mitigation projects and activities. For additional information regarding funding availability and eligibility, and other detail about and evaluation of these regulations, plans, and funding sources, see Appendix F.1-F.3.

Also, see Table 8.5.1-1 for further discussion and evaluation of key regulations and minimum standards that are implemented at the municipal level.

Table 8.3.1-1:
Summary of Selected State and Federal Regulations, Plans, and Funding Sources Relevant to Natural Hazard Mitigation

Title	Program Type	Administered by/ Eligible recipient		
		State	County	Municipality
Farm Bill Cons. Program/ Farm and Ranch Lands Protection Program	Funding (Fed.)	NJDOA/Div. of Agriculture and Natural Resources	X	X
FEMA Public Assistance (PA) grants	Funding (Fed.)	NJOEM	X	X
FEMA Hazard Mitigation Grant Program (HMGP)	Funding (Fed.)	NJOEM	X	X
FEMA Pre-Disaster Mitigation (PDM) grants	Funding (Fed.)	NJOEM	X	X
FEMA/NFIP Repetitive Flood Claims (RFC) grants	Funding (Fed.)	NJOEM	X	X
FEMA/NFIP Severe Repetitive Loss (SRL) grants	Funding (Fed.)	NJOEM	X	X
FEMA/NFIP Flood Mitigation Assistance (FMA) grants	Funding (Fed.)	NJOEM	X	X
National Dam Safety Program/ Water Resources Devt. Act (WRDA)	Funding (Fed.)	NJDEP/Dam Safety Section		(specific waterways explicitly identified in WRDA)
HUD Community Development Block Grants (CDBG)	Funding (Fed.)	NJDCA/Division of Community Resources	X	X
Land and Water Conservation Fund	Funding (Fed.)	NJDEP/Green Acres Program	X	X
USDA Forest Legacy Program	Funding (Fed.)	NJDEP/Green Acres Program		(available to private landowners)
NJ Open Space Program	Funding (local)	NJDEP/Green Acres Program	X	X
Community Wildfire Hazard Mitigation Assistance Program	Funding (NJ)	NJDEP/Forest Fire Service	X	X

Title	Program Type	Administered by/ Eligible recipient		
		State	County	Municipality
Shore Protection Program	Funding (NJ)	NJDEP/Ofc. of Engineering and Construction	X	X
Green Acres	Funding (NJ)	NJDEP/Green Acres Program	X	X
Coastal Blue Acres	Funding (NJ)	NJDEP	X	X
Farmland Preservation Program	Funding (NJ)	NJDOA/State Agriculture Devt. Committee	X	X
Flood Control Plan grants (1)	Funding (NJ)	NJ Meadowlands Commission		X
Municipal Assistance Program (1)	Funding (NJ)	NJ Meadowlands Commission		X
Freshwater Wetland Protection Act/ Wetland Mitigation Fund	Funding (NJ)	NJDEP	X	
Dam Restoration and Inland Water Projects Loan Program	Funding (NJ)	NJDEP	X	X
Sewerage Infrastructure Improvement Act Grants	Funding (NJ)	NJDEP	X	X
NJ Small Communities CDBG	Funding (NJ)	NJDCA/ Division of Community Resources	X	X
Environmental Infrastructure Financing Program	Funding (NJ)	NJDEP		Any public, private, or non-profit owned water system
Transportation Trust Fund Municipal Aid	Funding (NJ)	NJDOT/Division of Local Aid	X	X
Transportation Trust Fund	Funding (NJ)	NJDOT	X	
New Jersey Conservation Foundation (NJCF)	Funding (private)			(private program)
NJ Devt. and Redevt. Plan	Plan	NJDCA/OSG	X	X
Highlands Preservation Area	Regulation	NJDEP/DLUR		X
Watershed Permitting	Regulation	NJDEP/Municipal Stormwater Regulation Water Quality Div.		X
NJ Flood Hazard Area Control Act	Regulation	NJDEP/Flood Control Section		X
Uniform Construction Code	Regulation	NJDCA/Division of Codes		X
Uniform Fire Code	Regulation	NJDCA/Fire Safety Division		X
Flood Hazard Area Control Act	Regulation	NJDEP	X	X
Safe Dam Act	Regulation	NJDEP	X	X
Waterfront Devt. Statute and Coastal Permit Program	Regulation	NJDEP/DLUR		X
Coastal Area Facility Review Act (CAFRA)	Regulation	NJDEP/DLUR		X
Wetlands Act/ Coastal Zone Mgt. (CZM)	Regulation	NJDEP/DLUR		X
Stormwater Mgt. Rules	Regulation	NJDEP		X

Title	Program Type	Administered by/ Eligible recipient		
		State	County	Municipality
Tidelands Act	Regulation	NJDEP		X
Municipal Land Use Law	Regulation	NJDEP/B. of Land Use Compliance	X	

For many federal grants, the non-federal share can be borne by the state as "grantee", the recipient community as "subgrantee" or in some cases, the property owner who benefits from the project. In the case of property acquisitions intended to remove properties that experience repetitive flood losses, the non-federal share is typically covered by the property owner, who accepts the federal share of 75% and documents the lost equity as the non-federal share. This can serve as a disincentive to participation.

It is also important to note in this discussion of federal plans that on March 19, 2009, during the development of this Plan, FEMA approved a multi-year initiative called "Risk Mapping, Assessment and Planning" or "Risk MAP". The plan implementation spans FY10-FY14 and builds on the success of FEMA's Map Modernization program that will soon be concluding the work to provide reliable digital flood mapping for the majority of the Nation's population.

Per FEMA's website[1], the "vision for Risk MAP is to deliver quality data that increases public awareness and leads to action that reduces risk to life and property". One objective of the initiative is to "[r]educe losses of life and property through continuous improvement of mitigation plans", which is consistent with the goals and specific action items in this Plan. The Mitigation Action Plan for Middlesex County (see Section 9) includes an action item that specifically includes ensuring that Middlesex County takes full advantage of any opportunities that the Risk MAP program will provide.

8.3.2 Implications of NJOEM Capabilities on Local Hazard Mitigation Efforts

State capabilities for hazard mitigation have an impact on the efficacy of local planning and implementation. In accordance with the State Hazard Mitigation Plan, the focus of New Jersey's statewide hazard mitigation effort is centered in the New Jersey Office of Emergency Management (NJOEM), located in the Division of State Police.

NJOEM is represented on the State Hazard Mitigation Team, which is chaired by a representative of the Governor's Office. Other state agencies represented on the SHMT and actively involved in hazard mitigation include the Department of Environmental Protection (NJDEP), the Department of Community Affairs (NJDCA), the Department of Transportation (NJDOT), and the Department of Banking and Insurance (NJDOBI).

The SHMT has responsibility for the following, at a minimum:

- Identifying hazards, monitoring changes in hazard vulnerability, and implementing measures for reducing potential damage by providing a mechanism for follow-up activities crucial to the successful implementation of team recommendations.
- Developing and maintaining a comprehensive state hazard mitigation plan for the reduction of natural hazards.

[1] http://www.fema.gov/plan/ffmm.shtm

- Promoting public awareness of risks associated with known hazards and preparedness among residents of the State.
- Serving as an advisory group to the Governor's Advisory Council on Emergency Services (GACES) and preparing post-disaster hazard mitigation recommendations for all applications for assistance.
- Investigating and recommending cost-effective hazard mitigation opportunities to the NJOEM and the Governor's Advisory Council on Emergency Services as part of any disaster recovery effort.

Historically, NJOEM has had limited staffing to address the hazard mitigation needs of the State. Additional staff is needed to expand the ability of the state to support local and county mitigation planning needs. NJOEM needs to employ adequate staffing with the expertise, for the timely development of hazard mitigation plans and to facilitate the implementation of risk reduction projects statewide.

In the past, NJOEM has employed planning professionals and program administrators who conducted community outreach, mitigation workshops, and training opportunities to promote development of hazard mitigation plans, assist with developing alternative funding sources, and promote a statewide risk reduction strategy. Recent staffing loss and the inability to hire has left the State Hazard Mitigation program understaffed to meet the needs of county and local emergency management programs.

As stated in the SHMP, the state would benefit from hiring professional staff for the State Mitigation Unit to fulfill its responsibilities and manage its increased workload resulting from recent disasters; the addition of several FEMA funded mitigation programs, and commitments in the SHMP. Increased NJOEM staffing is needed in the areas of planning, engineering and project management.

In addition to the employment of professional staff, there is a need to develop a cadre to supplement disaster recovery operations and mitigation staff to assist NJOEM with education of affected communities, project assessment, and development of mitigation projects that have been recommended but not initiated. Such a cadre could be used to supplement state staffing during disaster recovery operations.

8.4 Capability Assessment for Middlesex County

In accordance with New Jersey's home rule structure, authority over the three key tools for proactive hazard mitigation – land use planning, floodplain management, and building code enforcement – reside at the municipal level. For more on this, see Section 8.5. Counties play a coordinating role in these matters.

8.4.1 Relevant Ordinances and Policies

This section, as illustrated in Table 8.4.1-1, provides a list of Middlesex County ordinances and policies that have the potential to affect and/or promote mitigation within the county. Understanding which ordinances and policies affect mitigation in the county is a helpful component to mitigation activities. Many of the ordinances and policies that most directly affect development in relation to hazards reside at the municipal level. These include zoning, floodplain management, and building code enforcement.

Table 8.4.1-1:
Middlesex County Ordinances and Policies Relevant to Hazard Mitigation
(Source: County Interviews)

Ordinance/ Policy	Description	Enforcement
Municipal Land Use Law	Encourages appropriate development in municipalities that promotes public health, safety, morals, and general welfare	Planning
Cross-Acceptance Report	Encourages consistency between municipal, county, regional, and state plans for development and redevelopment.	Planning
Open Space Master Plan	The County's Open Space Master Plan was adopted in 2004	Parks and Recreation

8.4.2 Fiscal Capacity

This section, as illustrated in Table 8.4.2-1, provides a list of local funding sources within Middlesex County and determines if that funding source can be used to affect or promote mitigation within the County. Understanding where potential funding sources are available to the county is a helpful component to mitigation activities.

Table 8.4.2-1:
Middlesex County Funding/Financing Sources Relevant to Hazard Mitigation
(Source: County Interviews)

Financial Resources	Accessible or Eligible to Use
General Fund	Yes
Development Fees	No
Community Development Block Grant (CDBG)	Yes
Capital Improvements Project Funding	Yes
Authority to Levy taxes for Specific Purposes	Yes
Fees for Water, Sewer, Gas or Electric Service	Yes
Green Acres Fund	Yes
Impact Fees for Homebuyers or Developers for New Developments/Homes	No
County Match Fund	Yes
Transportation Grant Funds	Yes
Federal Hazard Mitigation Grants	Yes (once the plan is approved by FEMA and adopted, participating jurisdictions will be eligible for HMGP, PDM, and other federal grants)

Through its bonding authority, the Middlesex County Improvement Authority (MCIA) can finance major infrastructure improvements. The county and municipalities can take advantage of low interest rates when financing projects this way. A program which the MCIA runs called the Capital Equipment and Improvement Program is new for 2008. This program allows the agency to provide financing for purchasing equipment and making capital improvements. The program, which closes in September 2008 and may be reauthorized for 2009 depending on participation, could lend itself to be an extremely effective way to finance hazard mitigation projects.

The county may also use monies from the County Match Fund or General Fund to assist municipalities in funding hazard mitigation projects. Generally, the following conditions must be met in order for a project to be considered for county funding: it must be developed in conjunction with the County Office of Emergency Management and NJOEM to be sure it utilizes the criteria priorities located within the State Hazard Mitigation Plan (SHMP) and the project must be reviewed and approved by the county freeholders. Additionally, counties may participate in projects that affect county infrastructure, including roads and drainage infrastructure.

8.4.3 Technical, Administrative, and Regulatory Capacity

This section provides a review of the administrative and technical resources within the county's departments to determine if all of the necessary resources are available to Middlesex County to engage in mitigation planning processes. Table 8.4.3-1 indicates potential resource needs, and indicates whether the county currently has staff with that expertise or available outside contractors.

Table 8.4.3-1:
Middlesex County Administrative and Technical Capacity
(Source: County Interviews)

Staff/Personnel Resources	On Staff	Department/Agency
Planner(s) or engineer with knowledge of land development and Land management practices	Yes	Planning
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	Yes	Engineering
Planners or Engineer(s) with an understanding of natural and/or human-caused hazards	No	
Floodplain Manager	No	
Surveyors	Yes	Engineer
Staff with education or expertise to assess the community's vulnerability to hazards	Yes	Engineer
Personnel skilled in GIS and/or HAZUS	Yes	Planning/Engineering
Scientists familiar with the hazards of the community	No	
Emergency Manager	Yes	OEM

Additionally, although most land-use related regulatory powers in New Jersey reside at the municipal level, counties have the ability to influence and guide development in important ways. These are discussed below.

Intra- and Inter-Jurisdictional Coordination

The County Office of Emergency Management reported having a good relationship with its municipal counterparts as well as other county departments. In the past, the majority of this interaction has been in response to events and not necessarily specific to hazard mitigation projects, however it is assumed with the development of this hazard mitigation plan there will be better communication or coordination on project implementation. The relationship with NJOEM is well established and close coordination has happened during previous interactions. The county has had only one event requiring significant FEMA interaction and it was reported that things went smooth and all parties involved were satisfied with the outcome.

Regionalization

Municipalities in New Jersey are currently being encouraged to consolidate ("regionalize") services and functions. These may include police, fire, EMS, limited emergency operations functions, and other items. In Middlesex County, even though the county freeholders are working towards shared services, the conversation process remains slow and for the most part the regionalization process has yet to begin.

Two areas to see some regionalization are communications and in the detection, deterring, response to and recovery from threats and incidents of terrorism. The New Jersey Urban Security Initiative (UASI) provides resources to state, county, and municipal governments to develop plans for terrorism events on a regional level. While this initiative focuses primary on operations and is still relatively a new concept, the coordination and cooperation being established will strengthen the process of regionalizing other services in the county.

In terms of regionalizing hazard mitigation efforts the county currently feels this would not work and the municipal OEMs should continue to remain responsible for their mitigation programs. Reasons for this revolve mainly around limited staffing at the county level that would not allow the close coordination needed to effectively manage a program of this type.

Land Use Planning and Regulation

The Middlesex County Planning Department has the authority to approve or reject all land development projects and site plans at the municipal level under the New Jersey Municipal Land Use Law. This gives the county some control and provides a mechanism for coordinated development. The Planning Department also has several divisions that have direct control over reducing or eliminating potential risks. These divisions are described briefly below.

The Division of Environment, Parks and Comprehensive Planning carries out a wide range of planning functions and programs relating to land use, environmental and infrastructure issues in Middlesex County. The Division is responsible for preparing and updating the land use and demographic elements of the County Comprehensive Plan. This division prepares and updates the Open Space and Recreation, Aquifer Protection, Water Supply, Wastewater Management, Storm Drainage, energy, and general environmental resources management elements of the County Plan. Division staff also conducts environmental and functional planning reviews required by other divisions under various regulations.

The Division of Land Development Review is responsible for reviewing development proposals (i.e. Subdivision and Site Plan Applications) to determine whether county roads/property and or drainage facilities would be adversely affected. The objective with this is to reduce hazards to the general public caused by unsafe traffic conditions and or flooding. The county also encourages municipalities to coordinate large development projects with them to address any transportation, wastewater, and storm drainage issues that may arise.

Floodplain Management

Floodplain management in Middlesex County is a function strictly handled at the municipal level of government. The county is not responsible for adopting of enforcing a minimum floodplain ordinance. At the municipal level, all 25 municipalities have adopted some type of ordinance that restricts or controls development or construction in flood prone areas. For more information on floodplain management and NFIP participation at the municipal level, see Section 8.5 and Appendix F.1-F.2 and F.4.

Building Code Enforcement

Building code enforcement in Middlesex County takes place at the municipal level of government. All municipalities are required by New Jersey law to enforce the New Jersey Uniform Construction Code. Building codes are either enforced by local inspectors or third party contractors. For more on building code enforcement at the municipal level, see Section 8.5 and Appendix F.1-F.2 and F.4.

Economic Development Planning

The Middlesex County Office of Economic Development acts as a liaison between business, government and other organizations which have impact on economic development. The department serves as the primary contact agency for businesses seeking assistance within the county, and acts as a clearinghouse for local, county, state and federal assistance programs and services. This includes providing property tax abatements and exemptions, various tax credits, and providing special grants to stimulate economic development. While there are no policies directly affecting at risk areas, the services provided do lend themselves to be potential mechanisms to incorporate hazard mitigation best practices.

Capital Improvements Planning

The County Treasurer, by law, is the custodian of all county funds and is responsible for meeting the county's long and short term capital fund requirements. Drainage projects and improvements to roads, bridges, and county facilities receive annual appropriations in the budget which are important projects in terms of hazard mitigation.

Land Conservation

Middlesex County maintains an active land conservation program through two specific programs, the Farmland Preservation Program and the Open Space Preservation Program. Funding for the Open Space Preservation Program comes partially through the State’s Green Acres program and also from a county open space tax. As such, the county is bound to all Green Acres regulations during the appraisal process of acquiring land which includes surveying, soil studies, etc. Once acquired, the land is typically designated as park or recreation land and is then maintained by the county.

While hazard mitigation may not formally be expressed as such in this process, much of the acquired land has been adjacent to bodies of water, wetlands, or part of existing county parklands and therefore reducing exposure.

8.5 Capability Assessment for Municipalities within Middlesex County

8.5.1 Overview of Relevant Statewide Mandatory Minimum Standards Related to Local Ordinances and Policies

New Jersey follows a "home rule" philosophy under which each municipality is directly responsible for local enforcement of building codes, floodplain management, emergency management, and zoning local ordinances.

In order to ensure a minimum set of standards, the state has passed laws and regulations mandating each municipality adopt local ordinances with the same basic criteria, so that jurisdictions may add additional requirements, but cannot have fewer/weaker requirements than the state standard. Having each municipality with a core set of policies, programs and capabilities at its disposal, allows for more effective mitigation against hazards, regardless of a municipality's relative size, population or wealth.

New Jersey mandates compliance with the Municipal Land Use Law, Uniform Construction Codes, Floodplain Management, and Growth Management, and strongly encourages land and water preservation through incentive programs. These mandates translate into local ordinances, policies or programs that regulate and enforce how zoning, building and open space in the Municipalities. Table 8.5.1-1 highlights the State Laws that drive the State's policies to support local jurisdictions' ability to impact hazard mitigation.

Table 8.5.1-1:
New Jersey Policies that Impact Municipal Hazard Mitigation Efforts
(Source: NJ State Hazard Mitigation Plan Update, 2008)

Policy	**Land Use Planning**
Description	State of New Jersey Municipal Land Use Law (MLUL) L.1975, c. 291, s. 1, eff. Aug. 1, 1976, is the legislative foundation of the land use process, including decisions by Planning Boards and Zoning Boards of Adjustment, in the State of New Jersey. It defines the powers and responsibilities of boards and is essential to their functions and decisions. It also provides the required components of a municipal Master Plan.
Applicability	Every municipal agency shall adopt and may amend reasonable rules and regulations, not inconsistent with this act or with any applicable ordinance, for the administration of its functions, powers and duties.
Effectiveness	The MLUL requires that each municipality prepare a comprehensive plan and update that plan every 6 years. These plans help jurisdictions review their land use plans and policies with public participation.
Policy	**Floodplain Management**
Description	NJ State Law Flood Hazard Area Control Act (N.J.S.A. 58:16A-52). The National Flood Insurance Act of 1968 is a federal program establishing the National Flood Insurance Program (NFIP), which enables property owners in participating communities to purchase insurance as protection against flood losses, in exchange for State and community floodplain management regulations that reduce future flood damages. As further incentive for communities to surpass the NFIP basic requirements, the Community Rating System (CRS) recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements.

Applicability	The Act and regulations attempts to minimize damage to life and property from flooding caused by development within fluvial and tidal flood hazard areas, to preserve the quality of surface waters, and to protect the wildlife and vegetation that exist within and depend upon such areas for sustenance and habitat. While it does not require local adoption, as it is enforced by the NJ Department of Environmental Protection. The floodplain ordinances of each municipality need to be reviewed to be in compliance with revised regulations (2007).
Effectiveness	Flood Hazard Control Act: Regulations for the Flood Hazard Control Act were adopted in November, 2007 so it is difficult to quantify the effectiveness at this time. See below for discussion of floodplain management activity at the county and municipal levels in Middlesex County. The NJ Dam Safety program, new state storm water management requirements, and the development of all hazard mitigation plans, are among of the efforts that can provide CRS credits for NJ municipalities.
Policy	**Building Codes**
Description	Uniform Construction Code (Uniform Construction Code Act of 1975) requires all jurisdictions to have current land use master plans (reexamined every six years), zoning, and other land development ordinances. The UCC contains subcodes for residential and other buildings, as well as requirements that address construction in both A and V flood zones. All new construction is required to comply with the UCC for flood zone construction. In the affected areas, older at-grade structures have been routinely razed and replaced with new and often larger structures, all now conforming to the NFIP's requirements for A-zone and V-zone construction. Thus, through the building boom of the 1990's and 2000's, there have been thousands of structures modified to FEMA's more stringent requirements, especially with respect to homes built on piling at or above the BFE for that zone. This in itself is a form of mitigation. However, there are still thousands of older homes still at grade that remain vulnerable to flood from storm surge and other sources.
Applicability	NJ State Law requires that all municipalities adopt ordinances that follow the UCC.
Effectiveness	Considered among the most effective elements in a mitigation program, because building codes mandate best practices and technology, much of which is designed to reduce or prevent damage from occurring when structures are under stress.
Policy	**Growth Management**
Description	The State Plan was prepared and adopted by the State Planning Commission according to the requirements of the State Planning Act of 1985 as amended (N.J.S.A. 52:18A-196 et seq.) to serve as an instrument of state policy to guide state agencies and local government in the exercise of governmental powers regarding planning, infrastructure investment and other public actions and initiatives that affect and support economic growth and development in the State.
Applicability	Through the Green Acres Program, Open Space Tax Program, State Development and Redevelopment Plan, and the State Planning Act, New Jersey has enhanced the traditionally limited role of county land-use planning and control. The State also provides tools for Municipalities when preparing their master plans and better opportunity for a comprehensive approach to planning so not to harm or be in conflict with neighboring Municipalities' plans.
Effectiveness	See below for discussion of land use planning and regulation as it applies to hazard mitigation in Middlesex County.

Policy	Critical Area Protection
Description	Green Acres Program; Blue Acres Program; Historical Preservation Program; Farmland Preservation
Applicability	These programs provide the funding necessary for Municipalities and Counties to purchase land for open space preservation and recreation.
Effectiveness	$3.3 billion for public investment in open space preservation and recreation have been made by the State since 1961. NJ residents have consistently voted for open space and recreation referendums at the State and local levels. In 2007 all 21 Counties and 231 Municipalities assessed a special tax for land preservation and recreation purposes. See below for further discussion of land conservation as it relates to hazard mitigation in Middlesex County.

8.5.2 Technical, Administrative, and Regulatory Capacity

As described above, capability as the municipal level was assessed trough the use of an online survey, augmented by research into other state source and interviews with county officials. The survey was targeted primarily to the primary contacts for this Hazard Mitigation Plan in each municipality (those who comprise the HMWG). Typically, these were municipal OEM coordinators. Others with relevant knowledge were solicited to participate as well, including those in the departments of planning, public works, and buildings. In Middlesex County, 14 out of 25 primary contacts participated (a response rate of 56%) as well as an additional three other municipal officials. For purposes of statistical consistency purposes, only primary contacts' responses are reported below.

Full data reporting for Middlesex County as well as the full results of each individual survey are contained in F.4.

Staffing and Personnel Capability for Hazard Mitigation

Municipal primary contacts in Middlesex County typically have significant experience and relevant training. Most respondents to the survey (77%) reported having been in their current position for more than five years. Only two were newer than one year. More than half of respondents (63%) reported a college education and 25% reported a background in fire, police, or EMT, as being relevant to their work. More than 25% reported taking FEMA/ICS courses.

Staffing, however, was often thin. The majority of respondents (57%) reported having three or fewer staff, although a small number of municipalities reported having upwards of 16 or 30 staff and one reported more than 50. Most respondents (65%) also reported having no staff to work in a hazard mitigation capacity, although one office reported having as many as 21-30 staff that had some mitigation component to their jobs. Only two municipal offices reported using contractors.

Only a few offices reported having staff trained in grant writing (2) or grant administration (2), and 100% stated that their staff could spend a total of zero-to-five hours per week on mitigation-related management duties. However, most (57%) of respondents said no other office would be a preferable location for hazard mitigation grant and project oversight.

Respondents reported moderate (36%) use of Geographic Information System (GIS). Thirty-three percent reported using the technology to identify hazard locations and an additional 33% reported using GIS to located buildings and infrastructure. Three out of six respondents reported their annual budget for GIS technology to be $10,000 or less.

Familiarity with FEMA mitigation programs was mixed. As shown in Figure 8.5.2-1, respondents had some familiarity with older FEMA mitigation grant programs such as Public Assistance Grant Program (PA), Hazard Mitigation Grant Program (HMGP), Pre-Disaster Mitigation Grant Program (PDM), and Flood Mitigation Assistance Grant Program (FMA); in each case, at least 70% of respondents reported a moderate or higher familiarity with these programs. Respondents were far less familiar with newer programs such as Severe Repetitive Loss Grant Program (SRL) and Repetitive Flood Claims Grant Program (RFC).

As Figure 8.5.2-2 shows, however, participation in FEMA grant programs has been very low in Middlesex County with the exception of the PA Program. The majority of respondents (72%) reported receiving PA funds for their municipality.

Figure 8.5.2-1
Respondent familiarity with FEMA mitigation funding sources
(Source: NJ Middlesex Municipal Capability Assessment Survey, 2008)

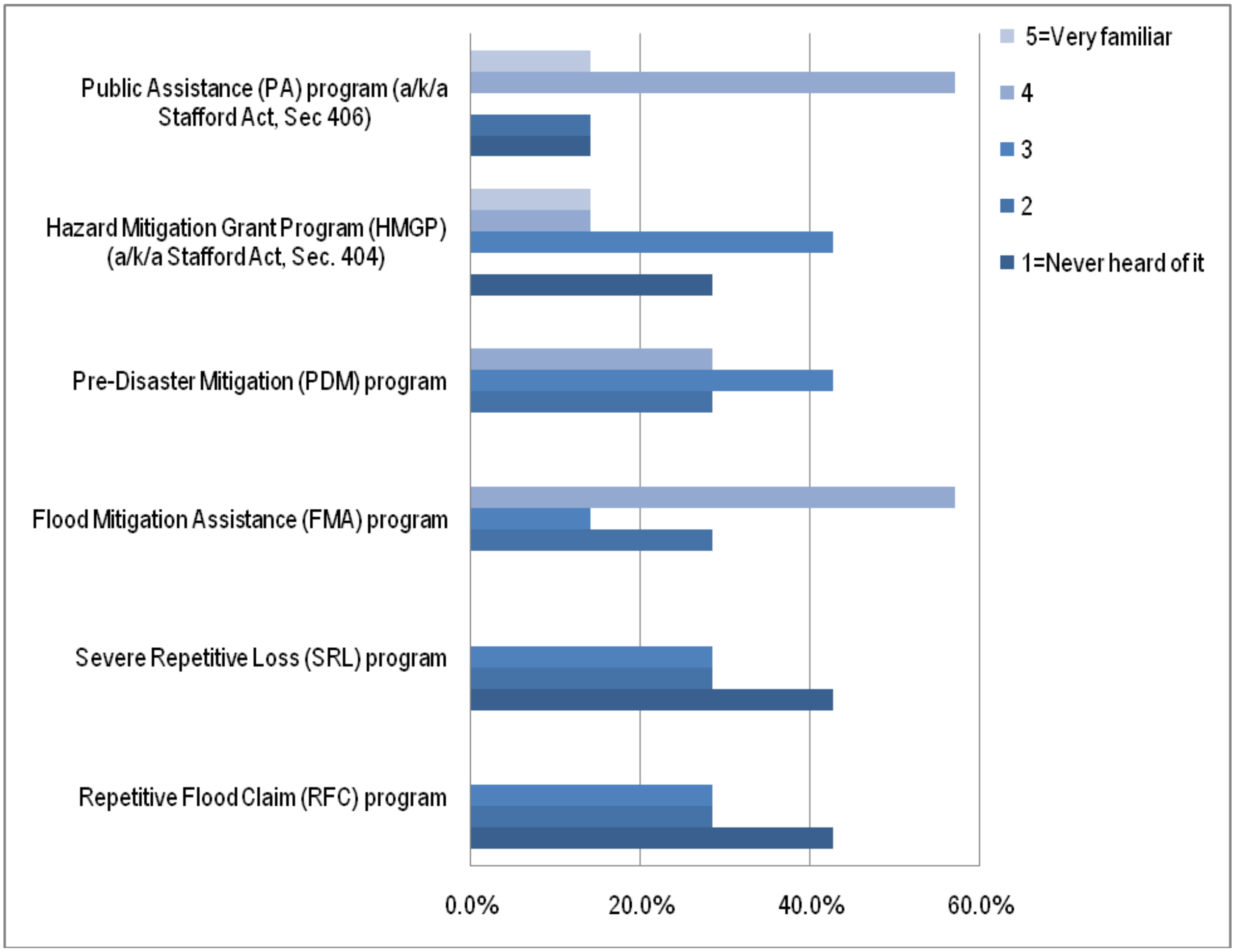
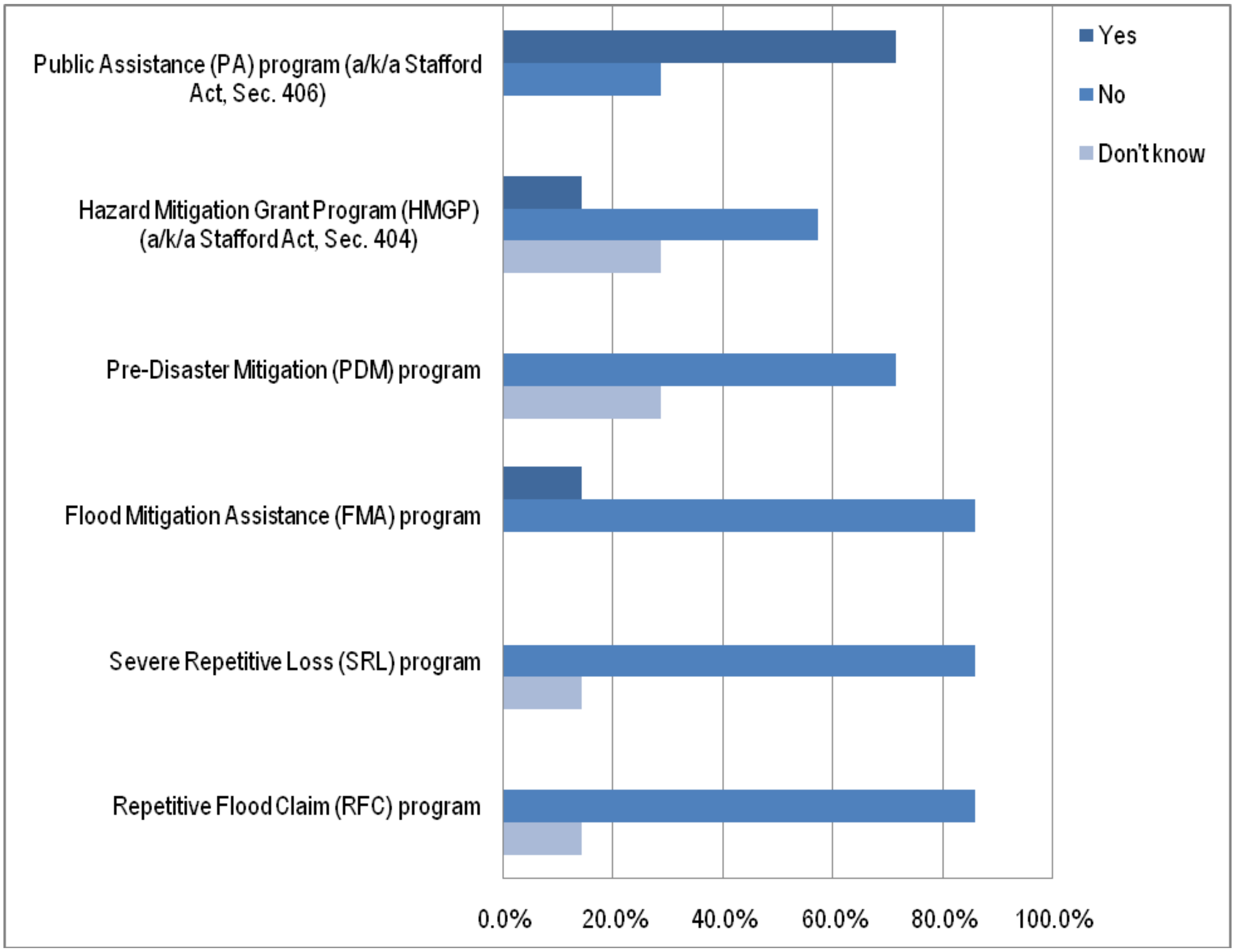


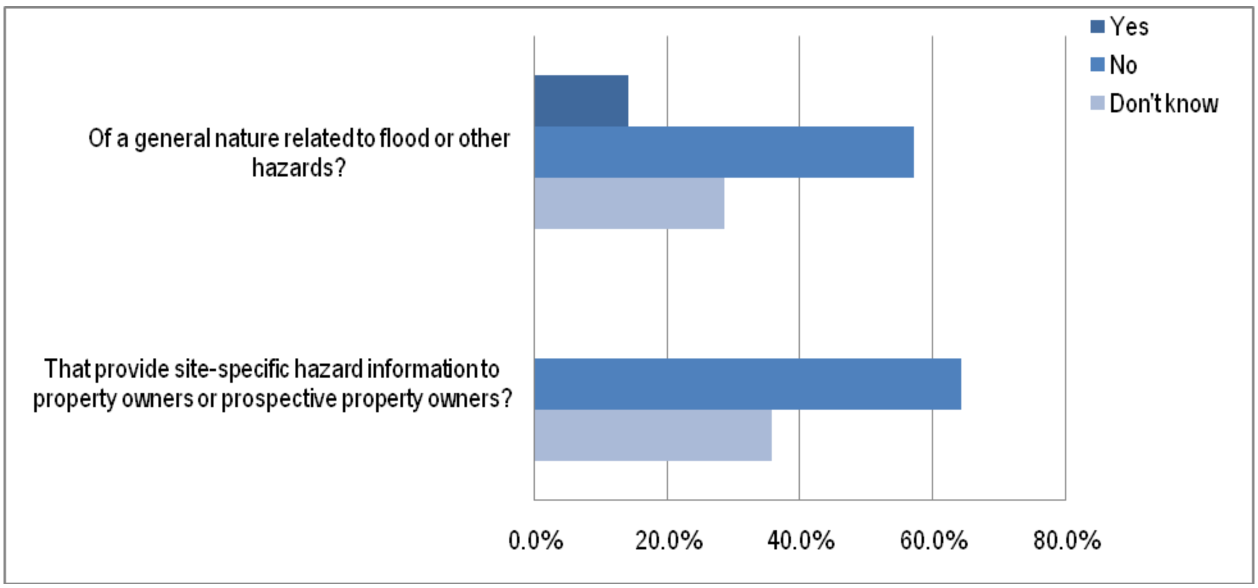
Figure 8.5.2-2
Municipal participation in FEMA mitigation programs
(Source: NJ Middlesex Municipal Capability Assessment Survey, 2008)



Very few respondents provided any insight into the effectiveness of mitigation programs in their municipalities and most agree (93%) their municipality does not have an active mitigation program. A Buffer Zone Protection Plan was the only measure cited as a successful mitigation program. Only one respondent proposed additional mitigation programs that would be useful in their municipality; they cited improvements to infrastructure.

As Figure 8.5.2-3 shows, few respondents reported that their municipalities maintain any public information programs related to hazard mitigation.

Figure 8.5.2-3
Existence of Municipal Public Education Programs Related to Hazard Mitigation
Source: NJ Middlesex Municipal Capability Assessment Survey, 2008



Intra- and Inter-Jurisdictional Coordination

Many municipal primary contacts coordinate their mitigation activities with other agencies, both within the same municipality and beyond it. Almost half (43%) of respondents reported that other municipal offices also carry out mitigation-related work, typically in the Department of Public Works (67%), the Building Department (67%), and the OEM (50%). Staffing in these other offices will range from a handful to more than 30 people. All respondents reported regular interaction with these other offices, either via email, phone, or face-to-face; 43% reported active partnering on mitigation efforts.

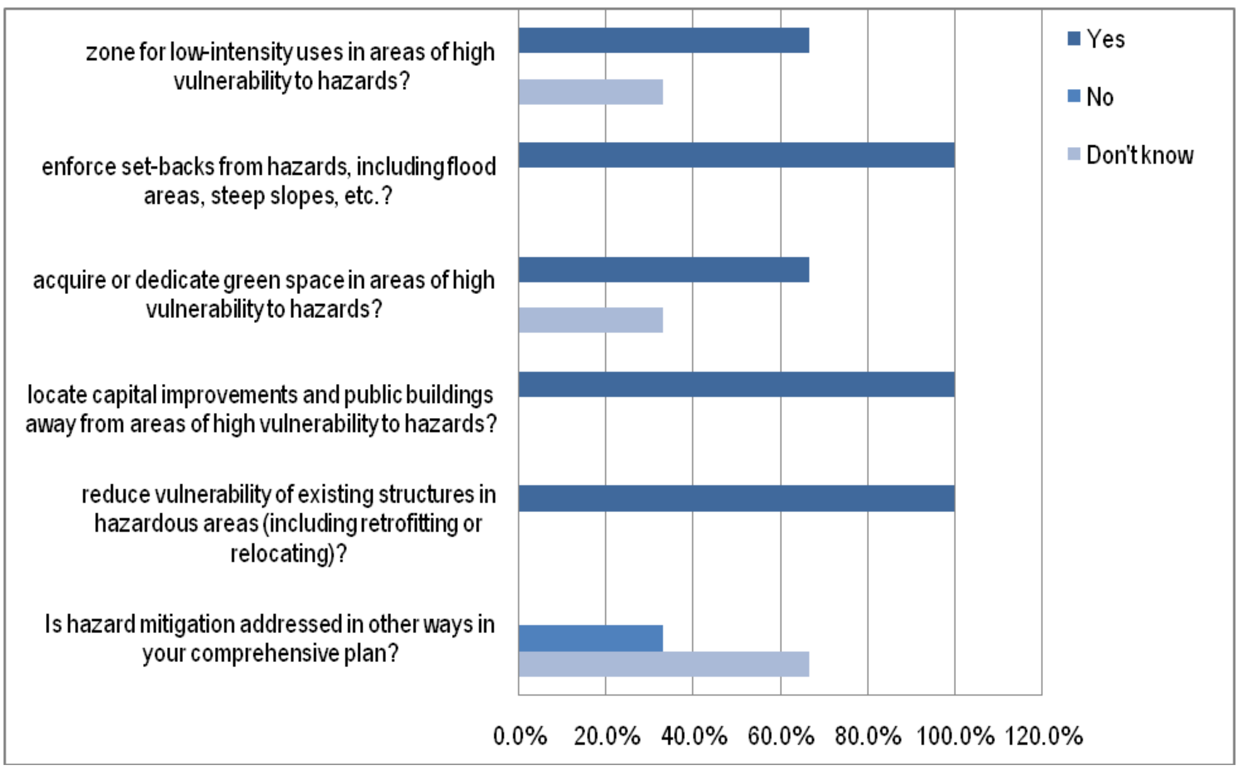
Most (67%) of respondents reported working with neighboring municipalities on mitigation efforts. All respondents reported working with the county, while 50% reported working with a regional planning entity, 50% reported working with state agencies, and 25% reported working with federal partners. Of all of these, the county OEM was rated the most valuable partner by 84% of respondents.

Land Use Planning and Regulation

Primary contacts who responded to the survey were mixed on their familiarity with land-use planning and regulation tools as they related to hazard mitigation, but those who were familiar with them tended to also be familiar with the ways in which these tools assist mitigation.

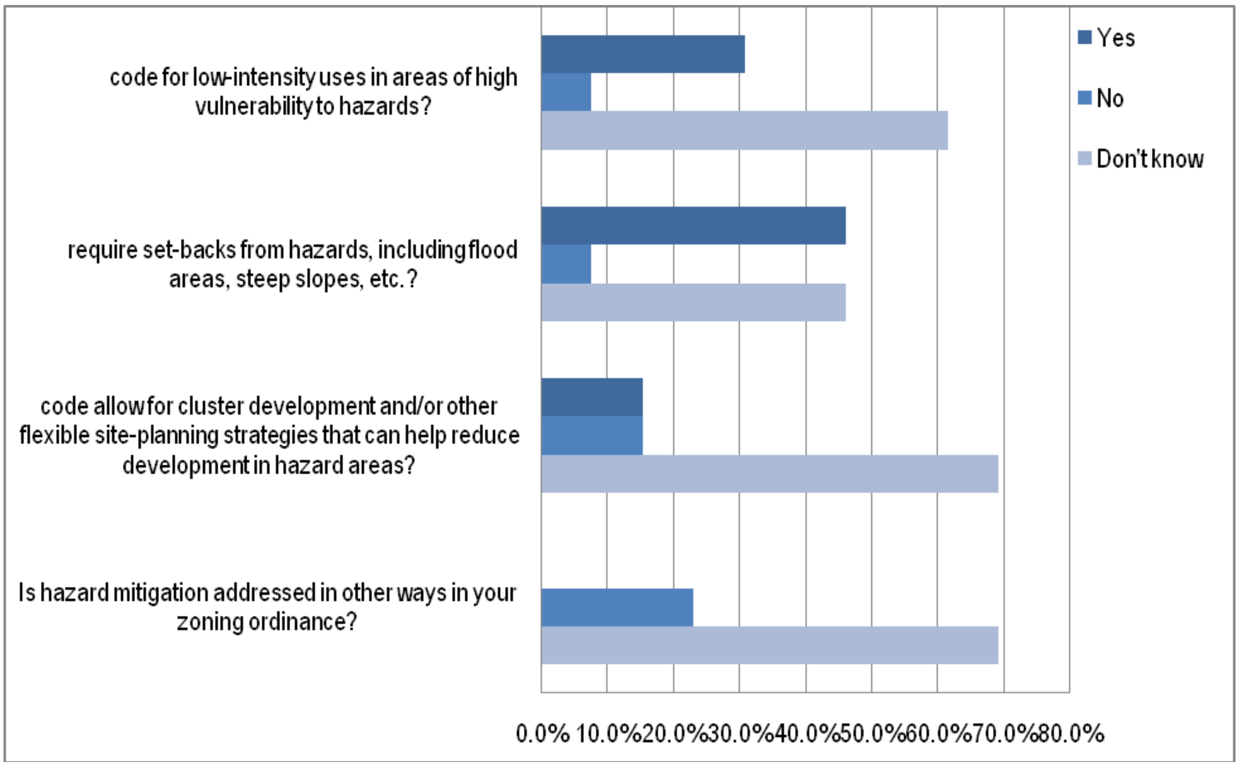
The majority of respondents did not respond or were not familiar with the content of their municipality's Comprehensive (Master) Plan, but those who were rated their plans highly for prioritizing mitigation, as shown in Figure 8.5.2-4. Comprehensive Plans were generally understood to call for establishing policies related to set-backs and other mitigation measures near flood areas, steep slopes, etc., locating capital improvements and public facilities away from hazardous areas, and reducing vulnerability of existing structures.

Figure 8.5.2-4
Hazard Mitigation Addressed in Municipal Comprehensive Plans
Answering question: 3 of 14
(Source: NJ Middlesex Municipal Capability Assessment Survey, 2008)



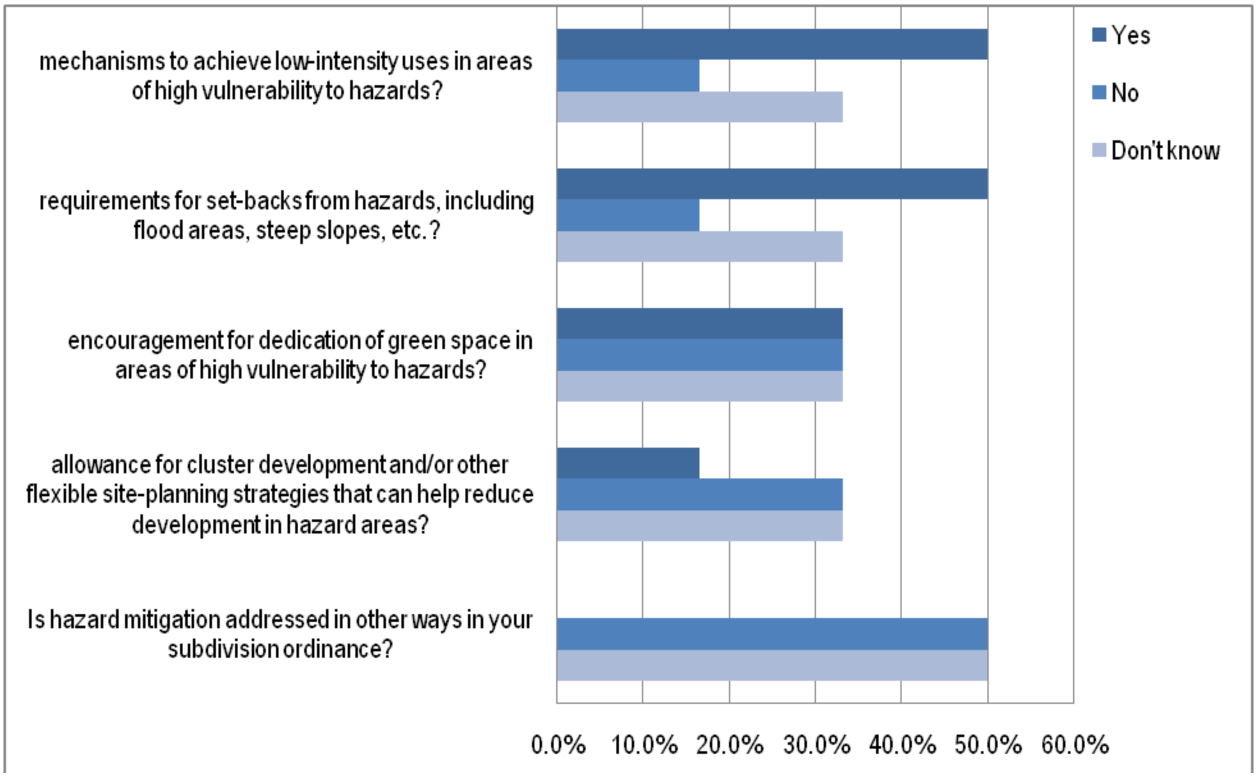
A large majority of respondents were not familiar with the content of their municipalities' zoning codes, as shown in Figure 8.5.2-5. Zoning codes were generally understood to call for limiting development in hazard-prone areas and establishing policies related to set-backs and other mitigation measures near flood areas, steep slopes, etc. Codes were also understood to allow for creative site-design solutions that can help mitigate hazards.

Figure 8.5.2-5
Hazard Mitigation Addressed in Municipal Zoning
Answering question: 13 of 14
(Source: NJ Middlesex Municipal Capability Assessment Survey, 2008)



A large majority of respondents were not familiar with their municipality's subdivision ordinance, but those who were rated their subdivision ordinance high for prioritizing mitigation, as shown in Figure 8.5.2-6. Subdivision ordinances were generally understood to call for limiting development in hazard-prone areas and establishing policies related to set-backs and other mitigation measures near flood areas, steep slopes, etc.

Figure 8.5.2-6
Hazard Mitigation Addressed in Subdivision Ordinance
Answering question: 6 of 14
(Source: NJ Middlesex Municipal Capability Assessment Survey, 2008)



Floodplain Management

The majority of respondents were familiar with administration of freshwater wetland rules or floodplain management in their jurisdictions. Well over half (64%) reported their municipality enforced freshwater wetland rules and 57% reported enforcing the Flood Hazard Control Act. Zero respondents reported their municipalities to ever over rule a decision for wetland permits or floodplain permits. As Table 8.5.2-1 shows, 25 of 25 municipalities in Middlesex County participate in the NFIP, meaning that they are required under state law to have adopted a floodplain management ordinance and have a designated floodplain manager. Fifty percent of respondents reported the Building Department administers the floodplain ordinances.

However, zero municipalities in the county take any of the additional steps to reduce their Community Rating System (CRS) score below the default rating of "10." Additional proactive steps can reduce the CRS rating, which in turn reduces property owners' NFIP premiums.

Table 8.5.2-1:
NFIP and CRS Participation in Middlesex County
(Source: FEMA)

Municipality	Participating in the National Flood Program as of 06/30/08	CRS Rating
Carteret Borough	X	--
Cranbury Township	X	--
Dunellen Borough	X	--
East Brunswick Township	X	--
Edison Township	X	--
Helmetta Borough	X	--
Highland Park Borough	X	--
Jamesburg Borough	X	--
Metuchen Borough	X	--
Middlesex Borough	X	--
Milltown Borough	X	--
Monroe Township	X	--
New Brunswick City	X	--
North Brunswick Township	X	--
Old Bridge Township	X	--
Perth Amboy City	X	--
Piscataway Township	X	--
Plainsboro Town	X	--
Sayreville Borough	X	--
South Amboy City	X	--
South Brunswick Township	X	--
South Plainfield Borough	X	--
South River Borough	X	--
Spotswood Borough	X	--
Woodbridge Township	X	10 (R)

Building Code Enforcement

Respondents reported that building code enforcement is most often (86%) the responsibility of a Building Department. Fifty eight percent of respondents reported that code enforcement offices to have five or more people. All inspectors were reported to be state certified.

Capital Improvement Planning

Most respondents (58%) reported that the executive leadership of their municipality oversees the capital improvement program. Very few (14%) reported that hazard mitigation projects are generally considered as part of the capital improvements program, however 21% reported that capital improvement projects themselves are assessed for hazard or hazard mitigation implications.

Land Conservation

Most respondents (71%) stated that their municipalities participate in land conservation programs such as Green Acres and Blue Acres. Administration of these programs was spread through the departments of environmental protection/quality, public works, building department and others. Thirty-three percent reported that Green Acres and Blue Acres funds are used for scenic or conservation landscape; however no respondents stated that such funds are used for any hazard mitigation purposes.

8.6 Current and Completed Hazard Mitigation Programs and Projects

This section provides a review of the completed hazard mitigation projects or programs and provides a description of potential or in-process projects or programs and the agency or agencies that the county worked with or is working with to complete the projects.

Table 8.6-1:
Current and Completed Hazard Mitigation Programs and Projects
(Source: County Interviews)

Program or Project	Description	Agency
Hazard Mitigation Plan	The county and its municipalities are currently in the process of developing a Multi-hazard, Multi-jurisdictional Hazard Mitigation Plan.	Middlesex OEM
Bridge Replacements	A project to re-bridge an area in Sayreville and South River is ongoing and has an effect on the waterways in this areas	NJDEP
South Central Middlesex County Flood Control Commission	The county has contributed $100,000 to study the drainage areas of the Manalapan Brook and Matchaponix Brook	SCMCFCC
Green Brook Flood Control Commission	The county has been a long time participant in the GBFCC to develop a comprehensive flood control solution for the entire Green Brook Basin	GBFCC

8.7 Summary and Conclusions

In conclusion, there are several areas which may be investigated further to determine the relevance of developing hazard mitigation strategies to fill gaps or shortcomings. Particularly these areas include: staffing, resources, and coordination.

As noted, there is often little to no staffing available at the local level to devote to hazard mitigation related activities. This includes project identification and data gathering, grant writing and application development, and the subsequent project management that follows an award of a grant. Outside assistance or an augmented staff with knowledge in hazard mitigation project management would be beneficial in bolstering Middlesex County's efforts in reducing future risk. It would also assist in preparing better project applications that may be selected based on a competitive selection process. Additional staff also creates the possibility to increase coordination at all levels of government.

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Section 9
Mitigation Action Plan

Contents of this Section

9.1 Interim Final Rule Requirement for the Mitigation Action Plan

Requirement §201.6(c)(3): *The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, an its ability to expand on and improve these existing tools.*

Requirement §201.6(c)(3)(i): *[The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.*

Requirement §201.6(c)(3)(ii): *[The mitigation strategy* ***shall*** *include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure. [The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.*

Requirement: §201.6(c)(3)(iii): *[The mitigation strategy section* ***shall*** *include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization* ***shall*** *include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.*

Requirement §201.6(c)(3)(iv): *For multi-jurisdictional plans, there* ***must*** *be identifiable action items specific to the jurisdiction requesting FEMA approval or credit of the plan.*

9.2 Hazard Mitigation Goals

This section contains goals, objectives and action items for the Middlesex County, New Jersey Multi-Jurisdictional Hazard Mitigation Plan. For the purposes of this Plan, the following definitions are proposed:

- **Goals** are general guidelines that explain what the County and participating municipalities want to achieve. Goals are expressed as broad policy statements representing desired long-term results.
- **Objectives** (or strategies) describe strategies to attain an identified Goal. Objectives are more specific statements than goals; objectives are also usually measurable and can have a defined completion date.
- **Mitigation Actions** are the specific steps (projects, policies, and programs) that advance a given Objective. They are highly focused, specific and measurable.

The hazard identification and risk assessment in Sections 6 and 7 consisted of identifying the hazards that affect Middlesex County and the potential for damage to community assets that are vulnerable to the hazards. Section 8 identified the strengths and weaknesses of state and local capabilities.
The goals and objectives described below, in Table 9.2-1 and following, were established by the Middlesex County Hazard Mitigation Steering Committee (HMSC) members in response to these assessment results. Many of the actions described below apply to the county and all participating municipalities.

The broad goals of the Middlesex Hazard Mitigation Plan are as follows:

- Goal 1: Improve **EDUCATION AND OUTREACH** efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact.

- Goal 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards

- Goal 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs and activities

- Goal 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs and activities

Specific objectives and actions to support these goals are described below in Table 9.3.2-1. Additionally, actions related to enhanced data collection (flood and critical facilities excepted) are described in Table 9.3.2-2 and municipality-specific actions are described in Table 9.3.3-1

For additional information related to state and federal programs and funding sources to support the below actions, please refer to Appendix F.1-F.3; in particular, for detail regarding limitations related to FEMA mitigation grant programs, see Appendix F-3, Table F.3-2.

9.3 Identification and Analysis of Mitigation Actions

9.3.1 Potential Mitigation Actions

Middlesex County has identified several hazard mitigation actions that would benefit the county. These were identified in the HMSC meetings, which included input from representatives of governmental organizations, local business, and private citizens. This was based in part on consideration of the range of potential mitigation actions for hazards faced by Middlesex County and its constituent municipalities are described below.

Public Awareness

Insurance industry and emergency management research has demonstrated that awareness of hazards is not enough. People must know how to prepare for, respond to, and take preventive measures against threats from natural hazards. This research has also shown that a properly run local information program is more effective than national advertising or public campaigns.

Although concerted local, county, and statewide efforts to inform the public exist, lives and property continue to be threatened when segments of the population remain uninformed or chose to ignore the information available. Public education serves to assist the communities with problems experienced from floods, hurricanes, tornadoes and thunderstorms/lightning/high winds as well as other lower priority hazards.

Educating the public of these life and property saving techniques must remain a high priority item at the local, state, and federal level and is consistent with Goal 1.

Projects identified by the HMSC are as follows:

- Develop *All Hazards* public education and outreach program for hazard mitigation and preparedness.
- Conduct yearly workshops related to FEMA hazard mitigation grant programs, including FMA, HMGP, PDM, SRL, and RFC, with a focus on those aspects available to private firms and property owners.
- Host a Hazard Awareness Week on an annual basis.
- Distribute information regarding flood and high wind hazards and potential mitigation actions in flood-prone areas.
- Conduct a Repetitive Loss Outreach Program (see discussion under "National Flood Insurance Program / Community Rating System" below).

National Flood Insurance Program, Floodplain Management, and Building Codes

Improved floodplain management, including land use planning, zoning, and enforcement at the local level can reduce flood related damages for both existing buildings and new development and are consistent with Goal 3. The use of the National Flood Insurance Program (NFIP) is critical to the reduction of future flood damage costs to the taxpayer.

About 17.9 percent of Middlesex County is located in a floodplain. All developments, regardless of the location, require a permit to include buildings, fill, and any other type development. In Middlesex County, the local municipality coordinates the necessary permits through their permitting and construction office.

The NFIP requires that when the cost of reconstruction, rehabilitation, addition, or other improvements to a building equals or exceeds 50% of the fair market value, then the building must meet the same construction requirements as a new building. Substantially damaged buildings must be brought up to new construction standards. A residence or building damaged so that the cost of repairs equals or exceeds 50% of the structure's fair market value must also be elevated above the Base Flood Elevation (BFE) in flood zones where BFE's exist.

See Table 9.3.1-1 for the dates when the communities of Middlesex County joined the NFIP. Each municipality within Middlesex County is expected to appoint a Floodplain Manager to enforce municipal floodplain ordinances. These ordinances are meant to addresses methods and practices to minimize flood damage to new and substantial home improvement projects, as well as addressing zoning and sub-division ordinances and state regulations as enforced through the New Jersey Department of Environmental Protection.

Table 9.3.1-1
National Flood Insurance Program

Name of Community	Date Joined NFIP
Carteret Borough	November 15, 1975
Cranbury Township	May 17, 1982
Dunellen Borough	April 1, 1977
East Brunswick Township	January 6, 1982
Edison Township	August 16, 1982
Helmetta Borough	October 16, 1984
Highland Park Borough	June 1, 1977
Jamesburg Borough	May 15, 1984
Metuchen Borough	December 4, 1979
Middlesex Borough	July 9, 1971
Milltown Borough	February 4, 1981
Monroe Township	April 17, 1985
New Brunswick City	December 4, 1979
North Brunswick	May 1, 1980
Old Bridge Township	November 15, 1985
Perth Amboy City	December 18, 1979
Piscataway Township	January 18, 1984
Plainsboro Township	June 19, 1985
Sayreville Borough	March 16, 1981
South Amboy City	December 4, 1979
South Brunswick	December 18, 1985
South Plainfield Borough	August 1, 1980
South River Borough	June 4, 1980
Spotswood Borough	December 18, 1979
Woodbridge Township	June 2, 1972

Within floodplain management as a whole, the education process must play an important role. As noted above, an effective education program should be implemented to show citizens the importance of building codes and ordinances and how cost effective they could be in reducing future damages.

Established through the NFIP, the Community Rating System (CRS) is a program that counties and municipalities can elect to join. Once a county has joined, participants receive a discount on their flood insurance premiums. As a result of being part of the CRS, the county would have to actively pursue public outreach programs. One of the requirements of CRS is an annual outreach project, such as a Repetitive Loss Outreach Program. This program would focus on repetitive loss areas within the county and consists of three main components. The first is to advise the homeowners that they live in a repetitive loss area and could be subject to flooding. The second is to give the homeowner appropriate property protection measure guidelines. The third is to make the homeowner aware of the basic facts about Flood Insurance.

The New Jersey Unified Construction Code is the mandated construction code for all New Jersey Communities. The State of New Jersey Department of Community Affairs issues licenses to all Construction Code and Sub-code officials that enforce the State's Uniform Construction Code.

However, the State's Department of Environmental Protection is the lead State agency for the administration of the State's Floodplain Management Program. Each community that participates in the National Flood Insurance Program must adopt and enforce municipal floodplain management regulations that meet or exceed the minimum requirements of the NFIP as directed by the State's Floodplain Management Program. This requirement is in addition to the enforcement of the State Uniform Construction Code. .

Each community in Middlesex County that is a participating community in the NFIP Program is required to have both a well trained Municipal Floodplain Manager and Construction Code Official. To ensure adequate enforcement of both codes, each community in Middlesex County should encourage additional training opportunities for all code enforcement personnel, to include its Municipal Floodplain Manager.

Floodplain management and building codes serve to assist the communities with problems experienced from floods, hurricanes, tornadoes, and thunderstorms/lightning/high winds as well as other lower priority hazards.

Flood Mitigation Actions

Retrofitting structures prone to periodic flooding is an effective mitigation technique to reduce the flood loss of property and is consistent with Goal 4. Techniques include the elevation of structures, acquisition, mitigation reconstruction, dry flood proofing, wet flood proofing, and drainage improvements and installation of generators.

Elevation: involves raising a structure on a new foundation so that the lowest floor is above the Base Flood Elevation (BFE). Almost any type and size of structure can be elevated.

Acquisition of structures: or "buyout" option is the most effective mitigation technique to reduce the loss of property due to flooding. The owners of repetitive flood loss structures sell their structure to the community on a cost share basis for the fair market value of the structure prior to the last flood event. The structure is demolished and removed with a deed restriction placed on the property for perpetuity, thus eliminating the structure from future flood damage. This approach is most effective when flood prone structures located within the same vicinity are grouped together and acquired. The remaining property can be converted into usable recreational space with minor structure restrictions.

Mitigation Reconstruction: is a component of the Severe Repetitive Loss (SRL) grant program that allows demolition and reconstruction of structures when traditional elevation cannot be implemented. This activity can be used for structures that were substantially damaged or destroyed. Currently this is a pilot program utilized mainly on the gulf coast but can be considered a potential approach to mitigation activities.

Dry flood proofing: techniques include the building of floodwalls adjacent to existing walls, the installation of special doors to seal out floodwaters, and special backflow valves for water and sewer lines. Wet flood proofing includes low cost mitigation measures such as raising air conditioners, heat pumps, and hot water heaters on platforms above the BFE.

Wet flood proofing: includes measures applied to a structure that prevent or provide resistance to damage from flooding while allowing floodwaters to enter the structure or area. Generally, this includes properly anchoring the structure, using flood resistant materials below the BFE, protection of mechanical and utility equipment, and use of openings or breakaway walls.

Application of wet flood proofing as a flood protection technique under the NFIP is limited to enclosures below elevated residential and non-residential structures and to accessory and agricultural structures that have been issued variances by the community.

Drainage: Improving the drainage capacity around roads and low-lying areas is a time-tested technique to mitigate flood damage. Maintenance of drainage canals and laterals is essential to maximize their efficiency and continued long term effectiveness. Actions in general to reduce the effects of flooding are widening and deepening the earthen canals, cleaning of existing ditches, and replacing existing culverts, upgrading pumps, and installing check valves and inverts in certain culverts. Maintaining and improving drainage serves to assist the communities with problems experienced from floods, hurricanes, tornadoes and thunderstorms/lightning/high winds.

Generators: Another cost effective retrofitting technique includes the installation of generators. By providing power with generators during and after severe storms many critical facilities may continue to provide necessary services to the community. The installation of generators serves to assist the communities with problems experienced from floods, hurricanes, tornadoes and thunderstorms/lightning/high winds.

Wind Retrofitting Mitigation Actions

Structures can be retrofitted to withstand high winds by installing hurricane shutters, roof tie-downs and other storm protection features. The exterior integrity is maintained by protecting the interior of the structure and providing stability against wind hazards associated with hurricanes. These types of measures can be relatively inexpensive and simple to put in place.

Another retrofitting technique is to bury electric power lines to avoid tree limbs falling on them or from wind damage resulting in a break in service to the consumer. Burying electric power lines serves to assist the communities with problems experienced from floods, hurricanes, tornadoes and thunderstorms / lightning / high winds.

Early Warning Systems

With sufficient warning of a flood, a community and its residents can take protective measures such as moving personal property, cars, and people out of harm's way. When a flood threat recognition system is combined with an emergency response plan that addresses the community's flood problems, considerable flood damage can be prevented. This system must be coupled to warning the general public, carrying out appropriate tasks, and coordinating the flood response plan with operators of critical facilities. A comprehensive education and outreach program is critical to the success of early warning systems so that the general public, operators of critical facilities, and emergency response personnel will know what actions to take when warning is disseminated.

Within Middlesex County's Emergency Operations Plan a Public Alert System is detailed. The activation of this system and timely release of emergency information to the public by all available media is vitally important.

Middlesex County would like to improve its public notification system to alert citizens of the county regarding the possibility of impending flooding caused by hurricanes, tropical storms, and heavy rains resulting from prolonged thunderstorms. A warning period is available for most emergency situations, although the amount of lead time may vary from hazard to hazard. Proper use of this warning period will save lives, reduce injuries, and protect property.

Early warning systems serve to assist the communities with problems experienced from floods, hurricanes, tornadoes and thunderstorms / lightning / high winds as well as other lower priority hazards.

Earthquakes

Significant seismic events, while not common to the region, do pose a potentially significant threat to Middlesex County and the surrounding area. The most practical preventative actions to be considered concerns appropriate building code enforcement. While this is not necessarily practical for existing structures except for renovations or reconstruction, there are activities that can be taken to mitigate further exposure to risk.

Building Retrofit: the use of reinforced concrete materials in combination with cross ties is a proven technique to provide current structures with additional stabilization. The addition of seismic stabilizer platforms for important of critical mechanicals within buildings will significantly reduce adverse impacts.

Hazardous Material Release – Fixed facilities

Within the confines of the county exists a significant density of hazardous materials manufacturing facilities or facilities that utilize these materials on a daily basis. Some effect protective and mitigating measures are:

Educational Outreach: develop and conduct educational outreach programs on the associated risks that close proximity to these facilities presents. The development of personalized family or business disaster plans in the event of release. These should be developed and conducted in partnership with the business community.

Evacuation Planning: This includes pre-identifying emergency evacuation routes and communicating that information to the public. In addition, people needing assistance, such as the elderly or those with special needs, should be identified and plans made to assist them if an evacuation were to occur.

Another component of evacuation planning is ensuring that shelter facilities will be available. Potential shelter locations must be identified and publicized and efforts must be made to ensure that the proper supplies and staff are available if the shelter is activated.

Hazardous Material Release – Transportation

While there are few hard and fast direct measures that may be taken, several that are available can be very effective.

Codes & Standards: Ensure that adequate training and enforcement of rules, regulations and standards for intermodal transportation carries are being carried out within the appropriate industries. This should include some public outreach as well.

Coordination of Hazard Expositions combined with demonstration exhibits dealing with a cross range of these potential hazards incorporating the business community and the public can be effective at reducing fears and concerns.

9.3.2 County-Wide Mitigation Actions

The HMSC developed the following program of mitigation actions in response to the risk and capability assessments (see Sections 7 and 8) that will be implemented on a county-wide basis. These general actions are presented in Table 9.3.2-1.

Table 9.3.2-1:
Middlesex County Hazard Mitigation Goals, Objectives, and General Actions

GOAL 1: Improve **EDUCATION AND OUTREACH** efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact.

Objective	Action	Priority (1)	Responsible Agency (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority
Objective 1.A: Increase awareness of risks and understanding of the advantages of mitigation by the general public and local government officials (see also municipal actions in Table 9.3.2-1)	1.A.1: Develop "All Hazards" public education and outreach program for hazard mitigation and preparedness through NJOEM and NJFS outreach See additional description regarding Action 1.A.1 on page 9-10.	High	County and municipal OEM, NJOEM NJFS	1 year	Middlesex County and municipal OEM personnel and existing state resources	Better informed populace creates a greater willingness and expectation to participate in mitigation actions.
	1.A.2: Initiate a public awareness program on local TV channel for hazard safety	Medium	County and municipal OEM	6 months to 1 year	Middlesex and municipal OEM personnel, local public TV	A better informed and involved population reduces risk and loss.
	1.A.3: Conduct evacuation exercises with and for local OEM personnel and private citizens	High	MCOEM	1 year	Middlesex and municipal OEM personnel, local business groups, citizen groups	Public participation lends to a more active emergency and preparedness response.
	1.A.4: Conduct yearly workshops related to FEMA hazard mitigation grant programs, including FMA, HMGP, PDM, SRL, and RFC, with a focus on those aspects available to private firms and property owners (coordinated with Action 1.B.1, below).	High	MCOEM, NJOEM	Ongoing	Existing state assets and federal grants	Making local officials and the public aware of federal grants increases participation.

GOAL 1: Improve **EDUCATION AND OUTREACH** efforts regarding potential impacts of hazards and the identification of specific measures that can be taken to reduce their impact.						
Objective	**Action**	**Priority (1)**	**Responsible Agency (2)**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 1.B: Increase local government official awareness regarding funding opportunities for mitigation	1.B.1: Conduct yearly workshops related to FEMA hazard mitigation grant programs, including FMA, HMGP, PDM, SRL, and RFC (coordinated with Action 1.A.4, above)	High	MCOEM, NJOEM	Ongoing	Existing state assets and federal grants	Making local officials aware of federal grants increases participation.
Objective 1.C: Increase local government official awareness regarding opportunities for participation in and contributing to future Plan updates.	1.C.1: Reach out to municipal Floodplain Administrators, depts. of planning, public works, engineering, etc. regarding the importance of hazard mitigation planning and provision of municipal plans and data for planning purposes.	High	MCOEM, municipal coordinators	Ongoing	Existing county and municipal resources	Makes local officials aware of benefits of plan participation.

County Action 1.A.1: Develop All Hazards public education and outreach program for hazard mitigation and preparedness

Responsible Agency: County and municipal OEMs.

MCOEM will implement a county-wide committee with local municipalities to develop an "All Hazards" Public Education and Outreach Campaign. The Hazard Mitigation Awareness and Education Campaign will include ***all natural hazards*** identified as applicable to Middlesex County.

To foster a more hazard-resilient community, MCOEM will work closely with external stakeholders – especially organizations that can provide technical information and/or assistance in the areas of hazard identification and risk assessment. Tapping into local resources, the County will institute a robust, multi-pronged campaign. Participating jurisdictions will work closely with MCOEM to ensure that the targeted outreach meets its intended audience.

County Tasks:

1. MCOEM will host Hazard Mitigation Awareness and Education Website on the Middlesex County website.
2. MCOEM and the Middlesex County Planning Department will be responsible for conducting outreach to other relevant stakeholders – e.g., FEMA, NJOEM, colleges and universities, Regional Planning Commissions, river and watershed-based non-profits, the NJ American Planning Association — and internal stakeholders— Middlesex County Departments of Planning, Health, Parks, and GIS. MCOEM and the Middlesex County Planning Department will create flyers for dissemination via the Middlesex County Fair and other Middlesex County events as well as for local distribution via municipal offices, libraries, schools, etc.
3. MCOEM and the Middlesex County Planning Department will each be identified as a local resource.

Participating Jurisdiction Tasks:

1. Jurisdiction will provide a direct link to the Middlesex County website from the jurisdiction website.
2. Jurisdiction OEMs (with/or Planning Department) will be responsible for identifying and engaging any local agencies or nonprofits that could serve as hazard and/or mitigation subject matter experts and providing contact information (and regular updates) to MCOEM for inclusion on the website.
3. Jurisdiction OEMs (with/or Planning Department) will publicize the website via in-person methods. In-person methods may and should be tailored to the community. Examples include the jurisdiction representative speaking at local fairs, May Day, little league games, and public meetings.
4. Jurisdiction OEMs (with/or Planning Department) will publicize the website via posting/distribution of the Middlesex County promotional flyer at high-visibility locations, e.g., municipal offices, libraries, schools, etc.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards

Objective	Action	Priority (1)	Responsible Agency (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority
Objective 2.A: Improve data availability to the county and participating communities for use in future planning efforts	2.A.1: Develop and maintain relationships with organizations that can provide technical information and/or assistance in the areas of hazard identification and risk assessment , e.g., incorporate information re: implementation of Risk MAP initiative as source of improved information re: flood risk in participating municipalities.	High	MCOEM, Rutgers University, NJGS, NOAA and USACE	Ongoing	Existing county staff, FEMA, NJOEM, Rutgers University, NJGS, other federal agencies including NOAA and USACE	Provides the basis for making decisions about where to focus mitigation activities, including further study, and eventually mitigation projects.
	2.A.2: Work with ongoing county, state, and federal efforts to develop and maintain hazard-specific geospatial data necessary to perform full risk assessments for all relevant hazards in Middlesex County	High	MCOEM	Ongoing	Existing county staff, FEMA, NJOEM, Rutgers University, NJGS, other federal agencies including NOAA and USACE	Essential step in developing mitigation actions.
	2.A.3: Undertake site-specific studies to better characterize flood risks to areas with extensive flood loss histories (see also municipal actions in Table 9.3.3-1 for additional detail).	Medium	MCOEM	Starting within six months, then ongoing	County OEM staff, municipal staff	Essential step in developing mitigation actions.
	2.A.4: Undertake detailed vulnerability assessments and develop mitigation options for critical facilities in V and VE zones.	High	County and municipal OEM	3-years	Existing staff	Step in process of securing grant funds to mitigate risks to these sites.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency (2)**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A, cont.:	2.A.5: Continuously update repetitive loss and severe repetitive loss lists from the NFIP.	Medium	County and municipal OEMs	Ongoing	Existing staff	Essential to continuing the county's efforts to reduce flood losses. Enables the county to appropriately prioritize its actions to mitigate repetitive loss and severe repetitive loss properties, in accordance with FEMA requirements (and potentially qualifies the county and local jurisdictions for the 90:10 federal-local match under the SRL program).
	2.A.6: Inventory critical facilities to identify those in geographic areas that may be prone to high ground motion during earthquakes (due to proximity to faults or to soil characteristics), and those with structures that may be at risk during an earthquake.	High	MCOEM and municipal OEMs, with support from NJGS.	1 year	FEMA grants, existing staff and resources	Allows risk-based decisions regarding protection of critical facilities.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency (2)**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A, cont.	2.A.7: Coordinate with state efforts to inventory or survey of prioritized areas to determine if there is a need for additional study or data collection related to wildfire and/or urban-interface fires. Focus of inventory/study will be on identifying areas where there exist vulnerable populations or built environment and/or areas where fuel loads and other conditions suggest potential for wildfire risk.	High	MCOEM, municipal OEMs, New Jersey Forest Fire Service, NJOEM	Ongoing	Existing resources and staff	Establishes basis for additional studies and eventually mitigation actions, if they are indicated.
	2.A.8: Undertake a survey of critical facilities to identify and prioritize those that may have structural characteristics that make them vulnerable to excessive snow and ice loads.	Medium	MCOEM, municipal OEMs,	Ongoing	Existing resources and staff	Basis for prioritizing actions, including mitigation.
	2.A.9: Coordinate with state efforts to maintain current information about fuel loads and conditions that may affect potential for fires.	High	MCOEM, municipal OEMs, New Jersey Forest Fire Service	Ongoing	Existing resources and staff	Provides a basis for risk assessment.
	2.A.10 Complete a detailed analysis of past losses related to nor'easters and other storms to determine if additional study is indicated. Work with State and federal agencies to develop a detailed characterization of erosion history and risks in particular.	High	MCOEM and Municipal OEM's with critical facilities; NJ State Climatologist	Ongoing	Existing resources and staff	Basis for determining if any additional study is warranted; data can be used as part of next plan update.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards

Objective	Action	Priority (1)	Responsible Agency (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority
Objective 2.A, cont.	2.A.11: Use best possible flood data, including DFIRM and Map Mod data, if available, in next plan update. Track implementation of Risk MAP initiative to ensure Middlesex County and municipalities gain full advantage of opportunities under this program.	High	Middlesex County and municipal OEMs	3 years	Existing staff	This is essential data for establishing flood risk.
	2.A.12: Maintain effective coordination and information sharing related to hazardous material sites with NJOEM and the Right to Know (RTK) Network.	Medium	MCOEM, RTK Network, NJOEM	Ongoing	Existing resources and staff	Provides a basis for prioritizing potential hazmat sites for further study and potential responses.
	2.A.13: Complete data collection for Geographic Information System (GIS) analysis and mapping of potential areas of impact related to hazardous material sites.	High	MCOEM, county agencies	Ongoing	Existing resources and staff	Provides a basis for prioritizing potential hazmat sites for further study and potential responses.
	2.A.14: Integrate data about hazardous materials with most current available information about other risk factors, e.g. population, climate, other site-specific characteristics.	Medium	MCOEM, county agencies, RTK Network, NJDEP, US Environmental Protection Agency (EPA)	Ongoing	Existing resources and staff	Potentially allows integration of hazardous materials information with data related to natural hazards.
	2.A.15: Complete a detailed analysis of past losses related to winter storms to determine if additional study is indicated.	High	Middlesex County and local agencies with critical facilities	2 years	Existing resources and staff	Provides a basis for determining if any additional study is warranted; data can be used as part of next plan update.

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency (2)**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.A, cont.	2.A.16: Complete a detailed analysis of past losses related to nor'easters and other coastal storms to determine if additional study is indicated. Work with state and federal agencies to develop a detailed characterization of erosion history and risks in particular.	High	Middlesex County and local agencies with critical facilities; New Jersey State Climatologist	3 years	TBD	Provides a basis for determining if any additional study is warranted; data can be used as part of next plan update.
	2.A.17: Work with appropriate agencies to identify specific areas that are vulnerable to storm effects, then inventory assets and populations in these areas as the basis for a risk calculation.	High	MCOEM, NOAA, USACE, local officials, NJDEP	3 years	TBD	Provides a basis for determining if any further risk assessment action is warranted.
	2.A.18: Work with NJDEP to more fully understand the dam hazard rankings and methodology behind them, particular regarding high-hazard sites.	High	MCOEM, NJDEP	3 years	NJDEP, USGS, NRCS	Provides a basis for further development and prioritization any future actions or strategies.
	2.A.19: Undertake more detailed engineering studies of dams that may pose risks to the county, based on additional data collected from state or federal agencies.	High	MCOEM, NJDEP, NJOEM	Ongoing	NJDEP, USGS, NRCS	Provides a basis for any additional work on risk assessment, or on specific mitigation actions, including modifications to structures, evacuation plans, or public information.
	2.A.20: Consolidate and incorporate relevant local data related to hazards, extent, probability, exposure, risk, history, etc.	High	MCOEM and Municipal OEMs	Ongoing	Existing resources	Basis for hazard identification, risk assessment, and mitigation strategies

GOAL 2: Improve **DATA COLLECTION, USE, AND SHARING** to reduce the impact of hazards						
Objective	**Action**	**Priority (1)**	**Responsible Agency (2)**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 2.B: Provide government officials and local practitioners with educational opportunities and information regarding best practices for hazard mitigation planning, project identification and implementation	2.B.1: Participate in the Emergency Preparedness Conference with workshops.	High	MCOEM, NJOEM NJFS	Ongoing	Existing state resources	The Emergency Preparedness Conference is an important venue to promote and increase participation in hazard mitigation programs and reaches a wide variety of people and interests.
Objective 2.C: Acquire and maintain detailed data regarding critical facilities such that these sites can be prioritized and risk-assessed for possible mitigation actions	2.C.1: Develop a database inventory of critical facilities countywide (county-, local-, and privately-owned), including fire and police stations, medical facilities, major public buildings important for emergency response and recovery, and critical lifeline transportation and utility nodes such as bridges, water treatment plants, wastewater treatment plants, high voltage electric substations, and hazardous materials facilities.	High	MCOEM, municipal OEMs	Ongoing	Existing staff, possibly consultants depending on funding availability.	Developing basic information such as this will allow the State to meet federal requirements for prioritizing mitigation grant funds that will be directed to reducing losses to critical facilities.
	2.C.2: Prioritize critical facilities and complete Phase 1 site surveys to identify vulnerabilities.	High	MCOEM, municipal OEMs	Commencing immediately, then ongoing.	Existing staff, possibly consultants depending on funding availability.	Essential first step in understanding risks and developing mitigation actions.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs and activities						
Objective	**Action**	**Priority (1)**	**Responsible Agency (2)**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 3.A: Continue support of hazard mitigation planning, project identification and implementation at the municipal and County level	3.A.1: Continue working with the State, as well as local jurisdictions to encourage their cooperation in making RL (and SRL) property mitigation a high priority, and to offer technical support in carrying out the requirements of FEMA mitigation programs	High	County OEM	Ongoing	Existing staff	Basic requirement to initiate and sustain program momentum.
	3.A.2: Provide grants information, planning tools, training and technical assistance to increase the number of public and private sector hazard mitigation projects.	High	Middlesex OEM, NJOEM, FEMA RII	Ongoing	Existing Resources, Mitigation Grant	Expanding the number of hazard mitigation projects will improve the county's resistance to hazards and reduce the impact of hazard events on its municipalities.
	3.A.3: Conduct direct outreach and education to municipal OEMs and other potential participants in Plan maintenance and future Plan updates	High	MCOEM	Ongoing	Existing resources	Increases efficacy and participation in hazard mitigation planning
	3.A.4: Work with NJOEM and FEMA to incorporate "recommended revisions" per NJOEM and FEMA Region II review of this Plan into future Plan updates.	High	MCOEM	Ongoing	Existing resources	Builds on successful completion of initial Plan and incorporates NJOEM and FEMA input.
Objective 3.B: Support increased NFIP/CRS participation	3.B.1: Conduct community outreach, workshops and training to increase NFIP participation	High	Middlesex OEM, NJOEM	Ongoing	Existing resources	Encourages participation in the program so that losses will be covered and allows eligibility in the FMA program.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs and activities

Objective	Action	Priority (1)	Responsible Agency (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority
Objective 3.B: cont'd	3.B.2: Encourage municipalities to participate in the CRS program, including potentially setting up CRS site visits and/or workshops for interested jurisdictions.	High	MCOEM, NJOEM	2 years	Existing resources	Encourages participation in the CRS program so that NFIP premiums can be reduced and floodplain management improved
	3.B.3: Encourage municipalities to include identification and prioritization of actions related to future participation in and compliance with the NFIP	High	MCOEM. Municipal OEMs	Ongoing	Existing resources	Encourages participation in the CRS program so that NFIP premiums can be reduced and floodplain management improved
Objective 3.C: Support increased integration of municipal/county hazard mitigation planning and floodplain management with effective municipal/ county zoning regulation, subdivision regulation, and comprehensive planning	3.C.1: Encourage enforcement of floodplain management as it relates to new and existing construction by integrating hazard mitigation practices with zoning, subdivision ordinances, comprehensive planning, and other land use tools at the municipal level.	High	Middlesex OEM, NJDEP, municipal officials	Ongoing	Existing Resources and Federal grant funds (FEMA CAP-SSSE)	To guide communities in a more effective control and use of floodplains.
	3.C.2: Encourage the NJ League of Municipalities to become more involved in mitigation activities, and in particular to support the activities described in Action 3.C.1 and 3.D.1.	High	MCOEM, NJOEM, NJ League of Municipalities	Ongoing	Existing staff	Advances all goals in the plan by increasing preparedness and knowledge of citizens, and law and policymakers.

GOAL 3: Improve **CAPABILITIES, COORDINATION, AND OPPORTUNITIES** at municipal and county levels to plan and implement hazard mitigation projects, programs and activities						
Objective	**Action**	**Priority (1)**	**Responsible Agency (2)**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
Objective 3.D: Elicit and support efforts by federal and state legislatures and agencies to address shortcomings in existing laws, programs and administrative rules related to hazard mitigation	3.D.1: Encourage enforcement of floodplain management as it relates to new and existing construction by integrating hazard mitigation practices with zoning, subdivision ordinances, comprehensive planning, other land use tools, and environmental and other regulatory mechanisms via state requirements, reviews, and regulations. Coordinate with the State Planning Commission to integrate the State Development and Redevelopment Plan and the SHMP.	High	Middlesex OEM, municipal building inspectors, zoning boards	Ongoing	Existing resources	To help guide communities in a more effective control and use of floodplains.
Objective 3.E: Provide for user-friendly hazard-data accessibility for mitigation and other planning efforts and for private citizens.	3.E.1: Develop a simple GIS platform, or build upon an existing platform, to maintain and analyze critical facilities inventories and information about hazards.	High	MCOEM, county agencies, in cooperation with other counties	1 year	Existing resources and staff	Provides a basis for understanding risks and maintaining most current information; provides a good means of maintaining data needed for period updates to the hazard mitigation plan; and (potentially) helps to identify promising sites mitigation actions and grant proposals.
Objective 3.F: Provide direct support, where possible, to municipal mitigation programs.	3.F.1: Explore potential for possible regionalization or consolidation of hazard mitigation planning, administration, and/or implementation at the county level	High	MCOEM	3 years	UASI	This could help support, coordinate, and consolidate hazard mitigation capabilities.

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs and activities

Objective	Action	Priority	Responsible Agency (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority
Objective 4.A: Facilitate development and timely submittal of project applications meeting state and federal guidelines for funding (1) for RL and SRL properties and (2) for hardening/retrofitting infrastructure and critical facilities with highest vulnerability ratings	4.A.1: Develop and implement a detailed severe repetitive loss mitigation strategy that will qualify the county and municipalities for 90:10 cost share under the FEMA SRL program.	High	Middlesex OEM, NJOEM	Immediate and ongoing	Existing local, state and federal funding programs.	Protects, people, property and response assets while removing high cost structures from the NFIP.
	4.A.2: Continue working with local and regional jurisdictions to encourage their cooperation in making RL (and SRL) property mitigation a high priority, and to offer technical support in carrying out the requirements of FEMA mitigation programs. Specifically, the County will ensure that municipalities have the most current and accurate information about RL and SRL properties.	High	Middlesex OEM, NJOEM	Ongoing	Existing staff, with support from NJOEM and FEMA RII.	Initiates a long-term process to protect property from effects of repetitive flooding.
	4.A.3: Promote acquisition and elevation of repetitive loss and severe repetitive loss structures (see Table 9.3.3-1 for further detail).	High	Middlesex OEM, NJOEM	Ongoing	Federal grants	To eliminate repetitive loss structures
	4.A.4: Implement mitigation projects and programs intended to reduce risk to critical facilities (see Table 9.3.3-1 for further detail)	High	Varied	Ongoing	Federal grants	To reduce exposure and risk to critical facilities
	4.A.5: Implement other mitigation projects and programs as appropriate at the municipal level (see Table 9.3.3-1 for further detail)	High	Varied	Ongoing	Varied	Varied

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs and activities

Objective	Action	Priority	Responsible Agency (2)	Projected Timeline	Projected Resources	Rationale for Action and Priority
	4.A.6: Work with NJGS and other County, State and federal agencies to better identify specific sites in the County that may be exposed to the effects of geo-hazards such as landslides, sinkholes and subsidence.	High	MCOEM NJDEP, NJGS	Ongoing	Existing Resources and Federal grant funds	Although risk does not appear to be particularly high from these hazards, there remains a need to better understand the hazards on a site-specific basis. Studies will be used as the basis for developing additional actions and strategies to mitigate risk, particularly when critical facilities are at risk.
Objective 4.B: Maintain and enhance local planning and regulatory standards related to future development and investments.	4.B.1: Integrate hazard mitigation Plan and priorities into floodplain management, zoning, subdivision regulation, and other local regulations as appropriate.	High	MCOEM, municipal OEMs and local permitting and planning offices	Ongoing	Existing County and Local Resources	Implements all goals by mitigating risk to new construction on a jurisdiction-wide basis
	4.B.2: Ensure full and effective enforcement of building codes, floodplain management, zoning, and other risk-reducing regulations.	High	MCOEM, municipal OEMs and local permitting and planning offices	Ongoing	Existing County and Local Resources	Advances all goals in the plan by ensuring effectiveness of existing local tools

GOAL 4: Pursue **OPPORTUNITIES TO MITIGATE** repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs and activities						
Objective	**Action**	**Priority**	**Responsible Agency (2)**	**Projected Timeline**	**Projected Resources**	**Rationale for Action and Priority**
	4.B.3: Integrate hazard mitigation priorities into Capital Improvement Plans, transportation planning, and other capital planning	High	MCOEM, municipal OEMs and local planning and engineering offices	Ongoing	Existing County and Local Resources	Advances all goals in the plan by ensuring consistency of major investments with mitigation priorities

Notes:

(1) Priority rankings were developed by MCOEM. See Appendix G and Table G-1 for details of STAPLEE analysis of these mitigation actions.

(2) In all of the action items in Table 9.3.2-1, MCOEM is indicated as one of the responsible agencies. In addition, there are several references to local agencies as responsible parties as well. One of the main roles of MCOEM in these actions - and in general regarding hazard mitigation planning and implementation - is support and facilitation of efforts to be encouraged at the local level. In some cases, municipalities have identified parallel action items (for example, County Action 1.A.1). In those situations, a specific relationship can be described and pursued as joint efforts. However, for most of these actions, the working relationships and specific responsibilities of MCOEM and the participating jurisdictions will need to be developed over time as part of the implementation of each action. It is envisioned that during the five-year period, MCOEM will be able to define workable programs with the municipalities on an on-going basis to better define these implementation strategies and keep workloads within the limits of county and local capabilities.

9.3.3 Municipality-Specific Mitigation Actions

Within Middlesex County, there are 25 participating municipalities. Strategies for hazard mitigation within Middlesex County and the municipalities were identified to reduce damage to those areas and conform to the requirements of the IFR. The following indicates the specific mitigation actions on a community by community basis including the rankings assigned to the projects by the municipalities.

Each participating municipality in Middlesex County identified mitigation actions and programs based upon the risk assessment (Section 7) and capabilities assessment (Section 8). These are detailed in Table 9.3.3-1, below. In all cases, these actions support Goal #4, i.e., pursue opportunities to mitigate repetitive and severe repetitive loss properties and other appropriate hazard mitigation projects, programs and activities.

Table 9.3.3-1:
Municipality Specific Mitigation Actions

	Hazard(s) addressed			**Responsible Party**		**Estimated**		
Carteret Borough								
Carteret 1: Storm-water drainage system upgrade and improvement for Carteret Fire/Police and EOC (located in same corridor)	Flood	Existing	Capital Improvement Plan	Municipality OEM	1 to 2 years	$265,000	FMA, PDM-C, and HMGP if available *Note #2*	High
Carteret 2: Working with NJDEP, develop a public outreach program to educate communities and residents that are subject to inundation as a result of rapid rise/storm surge.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	PDM-C and HMGP	High

	Hazard(s) addressed			Responsible Party		Estimated		
Carteret 3: Use United States Army Corps of Engineers (USACE) surge maps for community education and outreach.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	OEM Budget	High
Carteret 4: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
				Cranbury Township				
Cranbury 1: Branerd Dam structure hardening	Dam Failure	Existing	Capital Improvement Plan	Cranbury Twp Engineer	1-2 years from plan adoption date	$150,000	NJDEP HMGP, Fed Highway Administration	Low
Cranbury 2: Property Acquisition/Elevation of repetitive loss property	Flood	Existing	Flood Plain Management	Cranbury Twp OEM	1-2 years from plan adoption date	$350,000	FMA, PDM-C & HMGP if available *Note #2*	High
Cranbury 3: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
				Dunellen Borough				
Dunellen 1: Flood water management South side	Flood	Existing	Capital Improvement Plan	Engineering Department	2 years from plan adoption date	$900,500	FMA, PDM-C & HMGP if available *Note #2*	High

Mitigation action, program or project	Hazard(s) addressed	Existing or new structures	Existing implementation mechanism	Responsible Party	Target Date	Estimated cost ($)	Funding Source	Priority (3)
Dunellen 2: Public awareness program on local TV channel for hazard safety	All	Existing	Capital Improvement Plan	Dunellen OEM	6 months to 1 year	$5,000	Private Channel I	High
Dunellen 3: Code update	Seismic and wind	New	Building Code Ordinance	Building Department of each jurisdiction	3 years	Staff time	Dunellen Boro	High
Dunellen 4: Property acquisition/elevation of 3 repetitive loss properties located on Mountain View Terrace	Flood	Existing	Capital Improvement Plan	Dunellen OEM	2-4 years	$1.5 million	FMA, PDM-C & HMGP if available *Note #2*	High
Dunellen 5: Property acquisition/elevation of 2 repetitive loss properties located on 4th Street.	Flood	Existing	Capital Improvement Plan	Dunellen OEM	2-4 years	$1 million	FMA, PDM-C & HMGP if available *Note #2*	High
Dunellen 6: Property acquisition/elevation of 3 repetitive loss properties located on Jackson Ave.	Flood	Existing	Capital Improvement Plan	Dunellen OEM	2-4 years	$1.5 million	FMA, PDM-C & HMGP if available *Note #2*	High
Dunellen 7: Property acquisition/elevation of 4 repetitive loss properties located on N. Washington Ave.	Flood	Existing	Capital Improvement Plan	Dunellen OEM	2-4 years	$1.6 million	FMA, PDM-C & HMGP if available *Note #2*	High
Dunellen 8: Property acquisition/elevation of 2 repetitive loss properties located on Front Street.	Flood	Existing	Capital Improvement Plan	Dunellen OEM	2-4 years	$800.000	FMA, PDM-C & HMGP if available *Note #2*	High

	Hazard(s) addressed			Responsible Party		Estimated		
Dunellen 9: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
				East Brunswick Township				
East Brunswick 1: Propose regionalized coordination of dam releases on Manalapan Brook/ Develop Standard Operating Procedures	Flood	Existing	NA	County and Municipal OEM	6 months	Staff Time	Department Budget	High
East Brunswick 2: Harden Memorial School to FEMA 361 Standards	Wind	New	Capital Improvement Plan	Municipal OEM	2 years	$200,000	FMA, PDM-C & HMGP if available *Note #2*	High
East Brunswick 3: Backup power (generator) and/or utility protective measures for Memorial School	All	New	Capital Improvement Plan	Municipal OEM	2 years	$50,000	HMGP (5% initiative), PDM	Medium
East Brunswick 4: Develop "All Hazards" public education and outreach program for hazard mitigation and preparedness	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High

	Hazard(s) addressed			Responsible Party		Estimated		
East Brunswick 5: Property acquisition/elevation of 2 properties located on Squire St. and Yorktown Road.	Flood	Existing	Capital Improvement Plan	Municipal OEM	2 years	$900,000	FMA, PDM-C & HMGP if available *Note #2*	High
East Brunswick 6: Conduct fire-safe building sessions for area contractors.	Wildfire	New and Existing	Capital Improvement	OEM	6 months	$20,000	FMA, PDM-C & HMGP if available *Note #2*	Medium
East Brunswick 7: Create safety zones around critical facilities in wildfire risk areas.	Wildfire	Existing	Capital Improvement	OEM Coordinator	1-2 years	$20,000	NJDEP US Forestry Service	High
East Brunswick 8:: Implement Fire Wise Program throughout the Borough.	Wildfire	Existing and New	Emergency Management	OEM Coordinator	One Year	Staff Time	NJDEP Parks and Forestry	High
Edison Township								
Edison 1: Storm Water Management upgrade, elevation or relocation for (5 pumping stations)	Flood	Existing	Capital Improvement Plan	Municipal Public Works Department	2 years from plan adoption date	$500,000 per pump station.	HMGP, PDM, Capital Improvements	High
Edison 2: Check valves for sanitation system (non-maintenance-related costs only)	Flood	Existing	Capital Improvement Plan	Municipal Public Works Department (sewer)	2 years from plan adoption date	$10,000	FMA, PDM-C & HMGP if available *Note #2*	High

	Hazard(s) addressed			Responsible Party		Estimated		
Edison 3: Storm Water piping capacity increase	Flood	Existing	Capital Improvement Plan	Municipal Public Works Department (sewer)	2 years from plan adoption date	$500,000	FMA, PDM-C & HMGP if available *Note #2*	High
Edison 4: Building Code update	Seismic and wind	New	Building Code Ordinance	Municipal Code Enforcement	3 years	staff time	Department budget	High
Edison 5: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
Helmetta Borough								
Helmetta 1: Improvements to Helmetta Dam (Current County Project)	Dam Failure Flood	Existing	Capital Improvement Plan	Municipal Engineer	1 year	$800,000	NJDEP	Medium
Helmetta 2:- Work with County and South Central Middlesex County Flood Commission to dredge Cranberry Bogs to increase holding capacity	Flood	Existing	Capital Improvement Plan	Municipal OEM/ South Central Middlesex County Flood Commission	1 year	To be determined by engineer	County/ South Central Middlesex County Flood Commission	Low
Helmetta 3: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High

	Hazard(s) addressed			Responsible Party		Estimated		
Helmetta 4: Eliminate sanitary sewer infiltration and manhole rehabilitation near Snuff Mill (non-maintenance costs only)	Flood	Existing	Capital Improvement Plan	Municipal Department of Public Works/ Engineering	1 to 2 years	$200,000-$500,000	PDM, USDA Infrastructure Grant	Low
Highland Park Borough								
Highland Park 1: Based on jurisdiction determination work with NJDOT to eliminate flooding on Montgomery Street near Lincoln Avenue	Flood	Existing	Capital Improvement Plan	Municipal Department of Public Works	Based on jurisdiction determination	<$500,000	NJDOT FMA, PDM-C & HMGP if available *Note #2*	High
Highland Park 2: Backup power (generator) and/or utility protective measures for Highland Park Borough Hall (serves as EOC) and adjacent Senior Center	All	Existing	Capital Improvement Plan	Municipal OEM	1 year	<$250,000	HMGP (5% initiative), PDM, Capital Improvements	High
Highland Park 3: Notification System such as reverse 911 and/or warning sirens	All	NA	Capital Improvement Plan	Municipal OEM	1 to 2 years	To be decided by system specs chosen at time of application	HMGP (5% initiative)	High
Highland Park 4: Bring Police, Fire Station, First Aid Squad up to current codes and standards	All	Existing	Capital Improvement Plan	Municipal Public Safety Committee	3 years	$100,000	HMGP, PDM, Capital Improvements	High
Highland Park 5: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High

	Hazard(s) addressed			Responsible Party		Estimated		
				Jamesburg Borough				
Jamesburg 1: Install rip-rap along Manalapan Brook near William Street	Erosion Flood	New	Capital Improvement Plan	Municipal Administrator	6 months to 1 year	$50,000-$75,000	FMA, PDM-C & HMGP if available *Note #2*	High
Jamesburg 2: Storm sewer improvements along West Railroad Avenue, Hillside Avenue, and surrounding areas	Flood	Existing	Capital Improvement Plan	Municipal Administrator	1 year	$200,000	FMA, PDM-C & HMGP if available *Note #2*	High
Jamesburg 3: Storm-water management system upgrade and improvement along Manalapan Brook near Church Street and area surrounding Gatzmer Avenue	Flood	Existing	Capital Improvement Plan	Municipal Administrator	1 year	$300,000	FMA, PDM-C & HMGP if available *Note #2*	High
Jamesburg 4: Construct dam on Wigwam Lake near Prospect Street	Flood Dam Failure	New	Capital Improvement Plan	Administrator	1 year	$200,000	Dam Safety Program Grants,	Low
Jamesburg 5: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
				Metuchen Borough				
Metuchen 1: Storm Water Management system upgrade and improvement on Main Street between Woodbridge Avenue and Penn Avenue.	Flood	Existing	Capital Improvement Plan	Borough and Metuchen Public Works Department	2 years from plan adoption date	$250,000	HMGP, PDM, Capital Improvement, DOT funds	High

	Hazard(s) addressed			Responsible Party		Estimated		
Metuchen 2: Backup power (generator) and/or utility protective measures for Fire House	All	Existing	Capital Improvement Plan	Fire Department		$40,000	HMGP (5% initiative), PDM	High
Metuchen 3: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
Middlesex Borough								
Middlesex 1: Property acquisition/elevation of 1 Severe Repetitive loss property and 5 Repetitive Loss properties located on Marshall Place.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$300,000	FMA, PDM-C & HMGP if available *Note #2*	High
Middlesex 2: Property acquisition/elevation of 4 Repetitive Loss properties located on Rock Lane.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$375,000	FMA, PDM-C & HMGP if available *Note #2*	High
Middlesex 3: Property acquisition/elevation of 5 Repetitive Loss properties located on 1st Street.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$375,000	FMA, PDM-C & HMGP if available *Note #2*	High
Middlesex 4: Property acquisition/elevation of 9 Repetitive Loss properties located on 2nd Street.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$375,000	FMA, PDM-C & HMGP if available *Note #2*	High

	Hazard(s) addressed			Responsible Party		Estimated		
Middlesex 5: Property acquisition/elevation of 6 Repetitive Loss properties located on 3rd Street.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$375,000	FMA, PDM-C & HMGP if available *Note #2*	High
Middlesex 6: Property acquisition/elevation of 7 Repetitive Loss properties located on 5th & 6th Streets.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$375,000	FMA, PDM-C & HMGP if available *Note #2*	High
Middlesex 7: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
Milltown Borough								
Milltown 1: Repair and retrofit of main Street Dam	Flood	Existing	Capital Improvement Plan	Milltown Borough OEM	2 years from plan adoption date	$1 million	NJDEP Army Corps of Engineers	Low
Milltown 2: Relocation of Municipal Electrical Substation out of flood prone area.	Flood	Existing	Capital Improvement Plan	Milltown Borough OEM	1.5 years from plan adoption date	$12,000,000	HMGP, PDM	High
Milltown 3: Relocate Police/DPW Garage to out of Floodplain.	Flood	Existing	Capital Improvement Plan	Milltown Borough OEM	1 years from plan adoption date	$500,000	HMGP, FMA, PDM	High
Milltown 4: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High

	Hazard(s) addressed			Responsible Party		Estimated		
				Monroe Township				
Monroe 1: Install Back up generator at shelter: Monroe Twp High School 1629 Perrineville Rd Monroe Twp NJ 08831	All Hazards	Existing	Capital Improvement Plan	Monroe OEM	1 year	$40,000	HMGP 5% Initiative	High
Monroe 2: Install Backup generator at shelter: Mill Lake School 115 Monmouth Rd Monroe Twp NJ 08831	All Hazards	Existing	Capital Improvement Plan	Monroe OEM	1 year	$40,000	HMGP 5% Initiative	High
Monroe 3: Property acquisition/elevation of 2 Repetitive Loss properties located on Union Hill Road. & Spotswood Garvel Hill Rd.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$650,000	FMA, PDM-C & HMGP if available *Note #2*	High
Monroe 4: Property acquisition/elevation of 2 Repetitive Loss properties located on Carlton Ave & Ashmall Ave	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$300,000	FMA, PDM-C & HMGP if available *Note #2*	High
Monroe 5: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High

	Hazard(s) addressed			Responsible Party		Estimated		
				New Brunswick City				
New Brunswick 1: Storm-water management system upgrade and improvement for Verizon Tandem Office(9-1-1 switch for eastern seaboard)	Flood	Existing	Capital Improvement Plan	New Brunswick OEM	1 year	$200,000	FMA, PDM-C & HMGP if available *Note #2*	High
New Brunswick 2: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
				North Brunswick Township				
North Brunswick 1: Backup power (generator) and/or utility protective measures to Fire Station #2	All	Existing	Capital Improvement Plan	Fire Company	6 months	$65,000	HMGP (5% initiative), PDM-C, HMGP	High
North Brunswick 2: Backup power (generator) and/or utility protective measures to Fire Station #1	All	Existing	Capital Improvement Plan	Fire Company	6 months	$65,000	HMGP (5% initiative), PDM-C,HMGP	High
North Brunswick 3: Storm-water management system upgrade and improvement for Twp. Of NB - Water Utilities	Flood	Existing	Capital Improvement Plan	Fire Company	6 months to 1 year	$250,000	PDM	High
North Brunswick 4: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High

	Hazard(s) addressed			Responsible Party		Estimated		
Old Bridge Township								
Old Bridge 1: Acquisition of 4 properties	Flood	Existing	Capital Improvement Plan	Municipal Engineering Department	2 years from plan adoption date	$900,000	FMA, PDM-C & HMGP if available *Note #2*	High
Old Bridge 2: Dune stabilization and replenishment	Flood	Existing	Capital Improvement Plan	Municipal OEM and Engineering Department	2 years	$500,000	FMA, PDM-C, and HMGP if available *Note #2*	High
Old Bridge 3: Public awareness program on local TV channel for hazard safety	All	Existing	Capital Improvement Plan	Municipal OEM	6 months to 1 year	$5,000	Private Channel I	High
Old Bridge 4: Code update	Seismic and wind	New	Building Code Ordinance	Municipal Building Department	3 years	Staff time	Department budget	High
Old Bridge 5: Conduct fire-safe building sessions for area contractors.	Wildfire	New and Existing	Capital Improvement	OEM	6 months	$20,000	FMA, PDM-C & HMGP if available *Note #2*	Medium
Old Bridge 6: Create safety zones around critical facilities in wildfire risk areas.	Wildfire	Existing	Capital Improvement	OEM Coordinator	1-2 years	$20,000	NJDEP US Forestry Service	High
Old Bridge 7: Working with NJDEP, develop a public outreach program to educate communities and residents that are subject to inundation as a result of rapid rise/storm surge.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	PDM-C and HMGP	High

	Hazard(s) addressed			Responsible Party		Estimated		
Old Bridge 8: Use United States Army Corps of Engineers (USACE) surge maps for community education and outreach.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	OEM Budget	High
Old Bridge 9: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
Perth Amboy City								
Perth Amboy 1: Shelter enclosure/wind screen to protect critical response equipment at Municipal Marina	Wind	Existing	Capital Improvement Plan	Municipality OEM	6 months	$100,000	PDM-C & HMGP if available	High
Perth Amboy 2: Working with NJDEP, develop a public outreach program to educate communities and residents that are subject to inundation as a result of rapid rise/storm surge.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	PDM-C and HMGP	High
Perth Amboy 3: Use United States Army Corps of Engineers (USACE) surge maps for community education and outreach.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	OEM Budget	High

	Hazard(s) addressed			Responsible Party		Estimated		
Perth Amboy 4: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
Piscataway Township								
Piscataway 1: Mayflower Apartments waterproofing electrics	Flood	Existing	Capital Improvement Plan	Municipality OEM	1 year	$100,000	PDM-C & HMGP if available	High
Piscataway 2: Birchfield Apartments waterproofing electrics	Flood	Existing	Capital Improvement Plan	Municipality OEM	1 year	$100,000	Private	High
Piscataway 3: Rivercrest Apartments waterproofing electrics	Flood	Existing	Capital Improvement Plan	Municipality OEM	1 year	$100,000	Private	High
Piscataway 4: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
Plainsboro Township								
Plainsboro 1: Storm-water management system upgrade and improvement along Mapleton Road.	Flooding	Existing	Capital Improvement Plan	Plainsboro Twp. OEM	1 year	$100,000	State EMPG Fund	Medium
Plainsboro 2: George Davidson Road (Bridge) Debris Removal	Flooding	Existing	Capital Improvement Plan	Plainsboro Twp. OEM	1 year	$20,000	State EMPG Fund	Medium

	Hazard(s) addressed			Responsible Party		Estimated		
Plainsboro 3: Plainsboro Pond Dam Area debris removal to prevent flooding	Flooding	Existing	Capital Improvement Plan	Plainsboro Twp. OEM	1 year	$20,000	State EMPG Fund	Medium
Plainsboro 4: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
				Sayreville Borough				
Sayreville 1: Backup power (generator) and/or utility protective measures at Palaske Ave Water Tower for Communications Equipment	All-Hazards	Existing	Capital Improvement	Municipal OEM	1 Year1	$30,000-$40,000	HMGP (5% initiative), PDM-C, HMGP	High
Sayreville 2: Backup power (generator) and/or utility protective measures at Bordentown Ave Water Tower for Communications Equipment	All-Hazards	Existing	Capital Improvement Plan	Municipal OEM	1 Year	$30,000-$40,000	HMGP (5% initiative), PDM-C, HMGP	High
Sayreville 3: Evacuation Exercise for Sayreville Twp	All-Hazards	NA	Capital Improvement Plan	Municipal OEM	1 Year	~ $2,000	State EMPG OEM Budget	High
Sayreville 4: Acquisition/elevation of 1 Repetitive Loss Property on 6th Street.	Flood	Existing	Capital Improvement Plan	Municipal Engineering Department	1-4 years	$300,000	FMA, PDM-C & HMGP if available *Note #2*	High

	Hazard(s) addressed			Responsible Party		Estimated		
Sayreville 5: Conduct fire-safe building sessions for area contractors.	Wildfire	New and Existing	Capital Improvement	OEM	6 months	$20,000	FMA, PDM-C & HMGP if available *Note #2*	Medium
Sayreville 6: Create safety zones around critical facilities in wildfire risk areas.	Wildfire	Existing	Capital Improvement	OEM Coordinator	1-2 years	$20,000	NJDEP US Forestry Service	High
Sayreville 7: Working with NJDEP, develop a public outreach program to educate communities and residents that are subject to inundation as a result of rapid rise/storm surge.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	PDM-C and HMGP	High
Sayreville 8: se United States Army Corps of Engineers (USACE) surge maps for community education and outreach.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	OEM Budget	High
Sayreville 9: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
South Amboy City								
South Amboy 1: Upgrade Sewage Pump Station storm-water capabilities on Rosewell Street.	Flood	Existing	Capital Improvement Plan	Municipal Engineering Department	2 years from plan adoption date	$100,000	FMA, PDM-C & HMGP if available *Note #2*	High

	Hazard(s) addressed			Responsible Party		Estimated		
South Amboy 2: Working with NJDEP, develop a public outreach program to educate communities and residents that are subject to inundation as a result of rapid rise/storm surge.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	PDM-C and HMGP	High
South Amboy 3: Use United States Army Corps of Engineers (USACE) surge maps for community education and outreach.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	OEM Budget	High
South Amboy 4: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
South Brunswick Township								
South Brunswick 1: Storm-water management upgrade and improvement for Sewer Pumping Station #1	Flood	Existing	Capital Improvement Plan	Township of South Brunswick DPW	1 years from plan adoption date	$500,000	FMA, PDM-C & HMGP if available *Note #2*	High
South Brunswick 2: Stream mitigation to protect mobile home facility.	Flood	Existing	Capital Improvement Plan	Township of South Brunswick DPW	2 years from plan adoption date	$500,000	NJDEP FMA, PDM-C & HMGP if available *Note #2*	High

	Hazard(s) addressed			Responsible Party		Estimated		
South Brunswick 3: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
South Plainfield Borough								
South Plainfield 1: Acquisition of 23 homes located around New Market Avenue (specific streets include New Market Ave, Anthony Ave, Carmine Ave and Elsie Street)	Flood	Existing	Floodplain Management Plan	South Plainfield OEM	2 years	$5 million	FMA, PDM-C & HMGP if available *Note #2*	High
South Plainfield 2: Hardening/Retrofitting for EOC located on South Plainfield Ave.	Wind	Existing	Floodplain Management Plan	South Plainfield OEM	1 year	$210,000	FMA, PDM-C & HMGP if available HMGP 5% initiative *Note #2*	High
South Plainfield 3: Flood proofing, elevation, Hardening/Retrofitting, burying utility lines for Police building located on Plainfield Ave.	Flood/Wind	Existing	Floodplain Management Plan	South Plainfield OEM	1 year	$180,000	FMA, PDM-C & HMGP if available *Note #2*	High
South Plainfield 4: Hardening/Retrofitting, burying utility lines for FIRE/EMS located on Spring Lake Parks.	Wind	Existing	Floodplain Management Plan	South Plainfield OEM	1 year	$200,000	FMA, PDM-C & HMGP if available *Note #2*	High

Mitigation action, program or project	Hazard(s) addressed	Existing or new structures	Existing implementation mechanism	Responsible Party	Target Date	Estimated cost ($)	Funding Source	Priority (3)
South Plainfield 5: Construction of barrier around Water/Sewage facilities located on New Market Ave, Hadley Field Rd, Cedar Brooke Ave, Loaden Avenue	Flood	Existing	Floodplain Management Plan	South Plainfield OEM	1 year	$500,000	FMA, PDM-C & HMGP if available *Note #2*	Medium
South Plainfield 6: Harden/Retrofit Shelter (Franklin Elementary School) located on Franklin Ave.	Flood	Existing	Floodplain Management Plan	South Plainfield OEM	2 years	$95,000	FMA, PDM-C & HMGP if available *Note #2*	High
South Plainfield 7: Harden/Retrofit Shelter (South Plainfield Middle School) located on Plainfield Ave.	Flood	Existing	Floodplain Management Plan	South Plainfield OEM	2 years	$95,000	FMA, PDM-C & HMGP if available *Note #2*	High
South Plainfield 8: Harden/Retrofit Shelter (Kennedy School) located on Norwood Ave.	Flood	Existing	Floodplain Management Plan	South Plainfield OEM	2 years	$95,000	FMA, PDM-C & HMGP if available *Note #2*	High
South Plainfield 9: Harden/Retrofit Shelter (Roosevelt Elementary School) located on Jackson Ave.	Flood	Existing	Floodplain Management Plan	South Plainfield OEM	2 years	$95,000	FMA, PDM-C & HMGP if available *Note #2*	High
South Plainfield 10: Harden/Retrofit Shelter (Grant Elementary School) located on Cromwell Ave.	Flood	Existing	Floodplain Management Plan	South Plainfield OEM	2 years	$95,000	FMA, PDM-C & HMGP if available *Note #2*	High

	Hazard(s) addressed			Responsible Party		Estimated		
South Plainfield 11: Harden/Retrofit Shelter (Riley Elementary School) located on Morris Ave.	Flood	Existing	Floodplain Management Plan	South Plainfield OEM	2 years	$95,000	FMA, PDM-C & HMGP if available *Note #2*	High
South Plainfield 12: Harden/Retrofit Shelter (South Plainfield High School) located on Lake Ave.	Flood	Existing	Floodplain Management Plan	South Plainfield OEM	2 years	$95,000	FMA, PDM-C & HMGP if available *Note #2*	High
South Plainfield 13: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
South River Borough								
South River 1: Acquisition/elevation of 3 Severe Repetitive Loss and Repetitive Loss Properties on Causeway St	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$390,000	FMA, PDM-C & HMGP if available *Note #2*	High
South River 2: Acquisition/elevation of 2 Repetitive Loss Properties on Lee Street.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$130,000	FMA, PDM-C & HMGP if available *Note #2*	High
South River 3: Acquisition/elevation of 2 Repetitive Loss Properties on Armstrong Ave.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$150,000	FMA, PDM-C & HMGP if available *Note #2*	High

	Hazard(s) addressed			Responsible Party		Estimated		
South River 4: Acquisition/elevation of 2 Repetitive Loss Properties on Maple Street.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$150,000	FMA, PDM-C & HMGP if available *Note #2*	High
South River 5: Acquisition/elevation of 2 Repetitive Loss Properties on Herman Street & Leroy Street.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$120,000	FMA, PDM-C & HMGP if available *Note #2*	High
South River 6: Acquisition/elevation of 2 Repetitive Loss Properties on Levinson Ave & Cleveland Ave.	Flood	Existing	Capital Improvement Plan	Municipal OEM	1-4 years	$160,000	FMA, PDM-C & HMGP if available *Note #2*	High
South River 7: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
Spotswood Borough								
Spotswood 1: Retrofit freshwater well water pump station. George Street Pump Station.	Flood	Existing	Capital Improvement Plan	Spotswood Township OEM	2 years from plan adoption date	$100,000	PDM-C & HMPG	High
Spotswood 2: Conduct fire-safe building sessions for area contractors.	Wildfire	New and Existing	Capital Improvement	OEM	6 months	$20,000	FMA, PDM-C & HMGP if available *Note #2*	Medium
Spotswood 3: Create safety zones around critical facilities in wildfire risk areas.	Wildfire	Existing	Capital Improvement	OEM Coordinator	1-2 years	$20,000	NJDEP US Forestry Service	High

	Hazard(s) addressed			Responsible Party		Estimated		
Spotswood 4: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High
Woodbridge Township								
Woodbridge 1: Reconstruction of Rt. 35 culvert over the Herds Brook between North and South Park Drive (non-maintenance related costs only)	Flood	Existing	Floodplain Management Plan	Woodbridge Township OEM	2 years	$20 million	FMA, PDM-C & HMGP if available *Note #2*	High
Woodbridge 2: Reconstruction of Cove Creek culvert on Saints Boulevard (non-maintenance related costs only)	Flood	Existing	Floodplain Management Plan	Woodbridge Township OEM	1 Year	$10 million	FMA, PDM-C & HMGP if available *Note #2*	High
Woodbridge 3: Stream bank stabilization/ conveyance of the South Branch of the Rahway River from Merrill Park to New Dover Road.	Flood	Existing	Floodplain Management Plan	Woodbridge Township OEM	1 Year	$8 million	FMA, PDM-C & HMGP if available *Note #2*	High
Woodbridge 4: Cleaning of the River from Merrill Park to the culvert at Home Depot	Hazmat	Existing	Capital Improvement Plan	Woodbridge Township OEM	3 years	$4-5 million	NJDEP USDA	Low
Woodbridge 5: Stream Bank stabilization of the Pumpkin Patch Brook from Inwood Way to the Municipal Boundary.	Flood	Existing	Capital Improvement Plan	Woodbridge Township OEM	1 year	$5 million	FMA, PDM-C & HMGP if available *Note #2*	High

Mitigation action, program or project	Hazard(s) addressed	Existing or new structures	Existing implementation mechanism	Responsible Party	Target Date	Estimated cost ($)	Funding Source	Priority (3)
Woodbridge 6: Dredging of Smith's Creek from the Municipal Marina to the outlet at the Arthur Kill**.**	Flood	Existing	Capital Improvement Plan	Woodbridge Township OEM	1 year	$15 million	NJDEP, Army Corps of Engineers, USDA	Low
Woodbridge 7: Dredging of the Woodbridge Creek from the intersection with the railroad to the Trailer Court	Flood	Existing	Capital Improvement Plan	Woodbridge Township OEM	1 year	$5 million	NJDEP, Army Corps of Engineers, USDA	Low
Woodbridge 8: Construction of berm and tide gate along the Woodbridge Creek at Woodbridge Avenue to prevent flooding in the Crampton Avenue area.	Flood	New	Capital Improvement Plan	Woodbridge Township OEM	1 year	$10 million	NJDEP, Army Corps of Engineers, USDA	High
Woodbridge 9: Reconstruction of Port Reading Avenue and the Woodbridge Creek culvert to eliminate flooding (non-maintenance related costs only).	Flood	Existing	Capital Improvement Plan	Woodbridge Township OEM	2 years	$7 million	NJDEP, Army Corps of Engineers, USDA	High
Woodbridge 10: Continued restoration of remaining sections of the Woodbridge Creek tidal wetlands area from Port Reading Avenue to the outfall at the Arthur Kill.	Flood	Existing	Capital Improvement Plan	Woodbridge Township OEM	2 years	$10 million	NJDEP, Army Corps of Engineers, USDA	Medium

Mitigation action, program or project	Hazard(s) addressed	Existing or new structures	Existing implementation mechanism	Responsible Party	Target Date	Estimated cost ($)	Funding Source	Priority (3)
Woodbridge 11: Evaluation/analysis of Green Street Detention Basin Dam located southwest of the Intersection of US Route 1 and Green Street.	Flood	Existing	Capital Improvement Plan	Woodbridge Township OEM	1 Year	$75,000 *Note #1*	FMA, PDM-C & HMGP if available *Note #2*	High
Woodbridge 12: Improved conveyance/dredging (Going into Raritan Bay), waterway bank repairs, of Rahway River.	Flood	Existing	Floodplain Management Plan	Woodbridge Township	2 Years	$4 million	NJDEP, Army Corps of Engineers, USDA	Low
Woodbridge 13: Improved retention and engineering study to assess risk of dams.	Flood	Existing	Floodplain Management Plan	Woodbridge Township Engineer	3 year	$75,000 *Note #1*	FMA, PDM-C & HMGP if available *Note #2*	High
Woodbridge 14: Envelope hardening, securing external infrastructure, securing roof ballast and public outreach and education programs of Senior Citizen Complex.	Wind	Existing	Capital Improvement Plan	Woodbridge Township OEM	1 year	$1 million	FMA, PDM-C & HMGP if available *Note #2*	High
Woodbridge 15: Working with NJDEP, develop a public outreach program to educate communities and residents that are subject to inundation as a result of rapid rise/storm surge.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	PDM-C and HMGP	High

Mitigation action, program or project	Hazard(s) addressed	Existing or new structures	Existing implementation mechanism	Responsible Party	Target Date	Estimated cost ($)	Funding Source	Priority (3)
Woodbridge 16: Use United States Army Corps of Engineers (USACE) surge maps for community education and outreach.	Storm Surge	Existing	Capital Improvement	OEM	Ongoing	Staff time	OEM Budget	High
Woodbridge 17: Conduct all-hazards public education and outreach program for hazard mitigation and preparedness.	All	Existing and New	Emergency Management	OEM Coordinator, in coordination with MCOEM	One Year	Staff Time	PDM-C and HMGP	High

Notes:

(1) If a study is incorporated as an initial phase within a capital improvement project, it is more likely to receive federal funding from programs such as FMA, PDM-C and HMGP. If the study is a stand alone project, it is less likely that FEMA funded programs will be able to be utilized.
(2) Priorities and definitions of eligible projects under FEMA funding programs can change from year to year and disaster to disaster. Where multiple federal funding sources are identified under "Funding Source", the applicant will need to be aware of when notices of funding availability are published by FEMA and then carefully review to determine if a particular project will be eligible for that specific funding source. In addition, the definition and scope of the project may need to be adjusted to best conform to eligibility guidelines at the time of application
(3) Priority rankings were developed with the participation of the municipalities. See Appendix G, Table G-2 for details of STAPLEE analysis of these mitigation actions.

9.4 Flood Mitigation Projects

A significant percentage of the projects identified in Table 9.3.3-1 are related to flooding; 46 projects in all are related to flood hazards in the participating municipalities. The following exhibit, Figure 9.4-1, shows the relationship between designated floodplains and these projects.

Note that this map was developed in May 2009 using FEMA Digital Flood Insurance Rate Map (DFIRM) data. In September 2008, the DFIRM data became available for Middlesex County, and therefore was used as the basis for development of the map below. All other maps in the Plan displaying floodplain were produced prior to September 2008 and are based on FEMA Q3 data.

Table 9.4-1 shows the number of these projects that fall within the delineated flood zones[1]

Table 9.4-1−Flood Mitigation Projects versus Flood Zone Locations

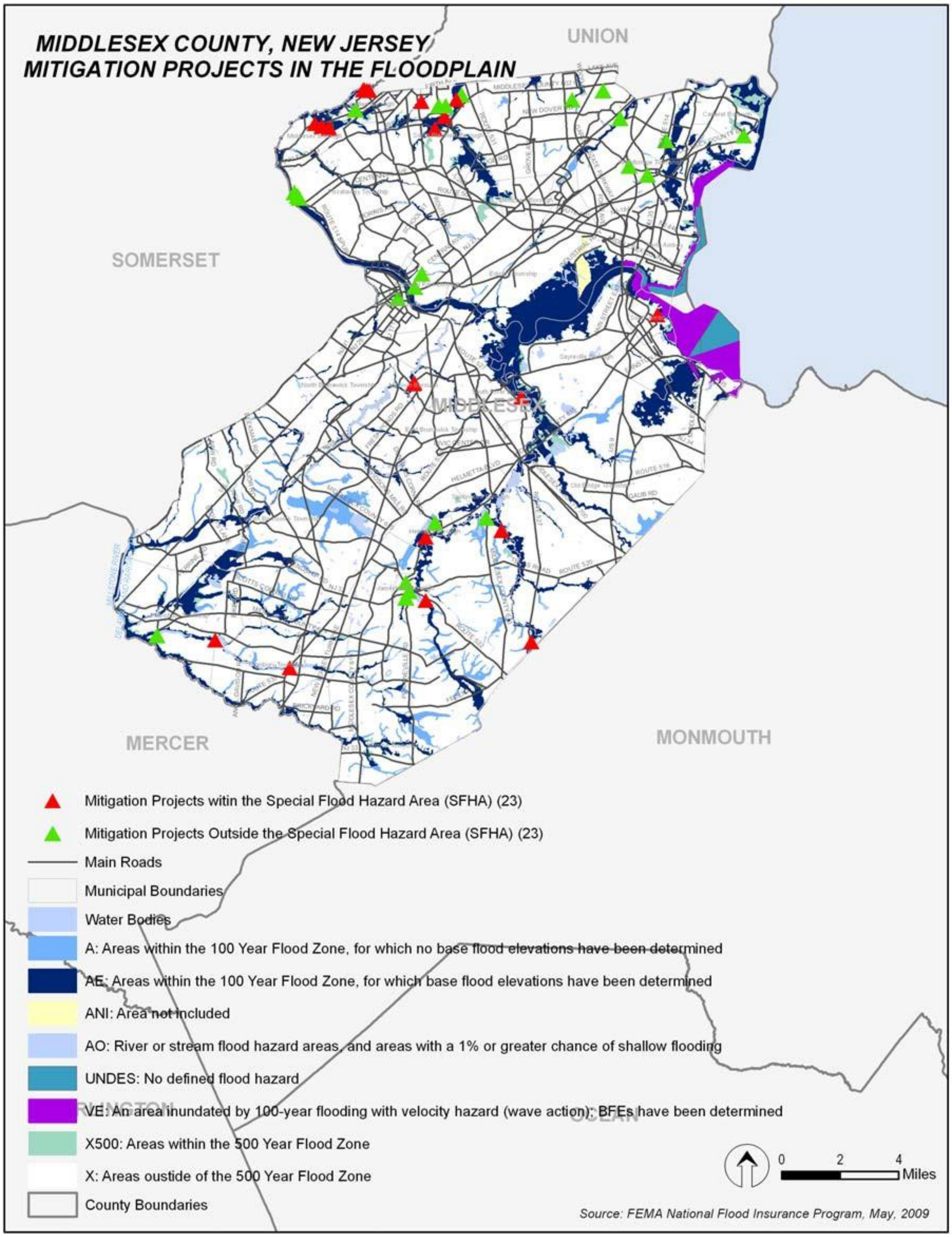
Flood Zone	Number of Flood Mitigation Projects
A	23
AE	23
Total	46

According to this tabulation, all of the flood mitigation projects fall into the A or AE flood zones.

Due to limitations in available data regarding structures in and around the flood zones, it is difficult to better correlate the current risk assessment and identified flood mitigation projects. However, there are several action items identified in this Section that are specifically intended to improve the available information for future Plan updates.

[1] The flood zone delineations used in this figure are per the Q3 data available to Middlesex for the initial flood risk assessment that was performed for this Plan. As referenced in the Mitigation Action Plan and in Section 10, MCOEM will consider updating the Plan when the DFIRMs are finalized and adopted by the Middlesex County Board of Freeholders.

Figure 9.4-1: Flood Related Mitigation Projects in Middlesex County, New Jersey



9.5 Prioritization and Implementation of Mitigation Actions

The preceding sections identify specific actions to achieve identified goals, an appropriate responsible party for each action, and a schedule for accomplishment and suggested funding sources. These tables also indicate an initial prioritization of the actions.

In the case of the county-wide actions, priorities were initially determined on a qualitative basis by the HMSC. The considerations were general feasibility and anticipated effectiveness in reducing risk. Detailed benefit cost analyses were not performed (see notes below) but general cost effectiveness of the types of actions being considered was taken into account.

In addition, an analysis of these actions was undertaken in a systematic way that is called the *Social, Technical, Administrative, Political, Legal, Economic, and Environmental* (STAPLEE) method. Table 9.5-1 describes the basic steps in the STAPLEE methodology.

Table 9.5-1−STAPLEE Methodology

STAPLEE	Criteria Explanation
S–Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population, do not cause relocation of lower income people, and if they are compatible with the community's social and cultural values.
T–Technical	Mitigation actions are technically most effective if they provide long term reduction of losses and minimal secondary adverse impacts.
A–Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding.
P–Political	Mitigation actions can truly be successful if all stakeholders been offered an opportunity to participate in the planning process and if there is public support for the action.
L–Legal	It is critical that the jurisdiction or implementing agency the legal authority to implement and enforce a mitigation action.
E–Economic	Budget constraints can significantly deter the implementation of mitigation actions. Hence, it is important to evaluate whether an action is cost-effective, as determined by a cost benefit review, and possible to fund.
E–Environmental	Sustainable mitigation actions that do not an adverse effect on the environment, that comply with federal, state, and local environmental regulations, and that are consistent with the community's environmental goals, mitigation benefits while being environmentally sound.

This method was used by MCOEM to weigh the various criteria for each of the identified actions and objectives including the relative cost-effectiveness as part of the "Economic" criteria. The resulting priority rankings are shown in Table 9.3.2-1. The detailed scoring of each action for each criterion is shown in Table G-1 in Appendix G.

For the municipal mitigation actions, initial priorities were set in a similar manner by the Local Coordinators; the mitigation action items with highest priority were generally considered to be the most cost effective and most compatible with the communities' social and cultural values.

The mitigation actions for the municipalities were also analyzed using the STAPLEE criteria and results reviewed and approved by each of the municipal coordinators. The resulting priority rankings are shown in Table 9.3.3-1. The detailed scoring of each action for each criterion is shown in Table G-2 in Appendix G.

Per the results of the Capability Assessment in Section 8, of particular concern regarding the effective implementation of mitigation actions and strategies is that there is often little to no staffing available at the local level to devote to hazard mitigation related activities. Staffing, resources, and coordination of effort are at a premium with little chance of significant change to these issues in the foreseeable future. Therefore, the inclusion of any specific action item in this document does not commit the County or municipalities to implementation. Each item will be considered for implementation in terms of the available staff and funding resources on a periodic basis. In addition, certain items may require regulatory changes or other decisions that must be implemented through standard processes, such as changing regulations.

Individual communities will implement identified projects with their own resources as they are able to program capital improvement funds. The individual municipalities will generally follow the priorities set in this plan although variations in funding may alter the specific order. However, it is anticipated that the majority of the actions in the Plan will be implemented as funds become available through various federal mitigation grant programs.

The HMSC will also use the STAPLEE methodology to help them consider and prioritize potential action items for funding applications at that time

The HMSC determined that it will be appropriate to revisit this STAPLEE analysis when funding is either available or being actively sought, because the qualitative characteristics of certain projects or priorities may shift over time or as a result of changing circumstance.

Once funding sources are identified (e.g., via grant announcements from NJOEM or FEMA) the list of mitigation actions will be reviewed to select actions that meet the particular grant criteria. Then, the Middlesex HMSC, working in coordination with the Local Coordinators will determine priority rankings for the short list of projects. Tentatively, the HMSC has defined High, Medium, and Low priorities to be assigned in this process as follows:

- High: Meets five of the seven STAPLEE criteria
- Medium: Meets four of the seven STAPLEE criteria
- Low: Meets three of the seven STAPLEE criteria

Depending on the available grant funding, the HMSC, again working with the Local Coordinators, will determine how many of the selected and prioritized projects should be submitted for funding starting with the highest priority projects as determined at the time.

Benefit-Cost Analysis

Per the IFR, communities are required to use benefit cost analysis to prioritize projects for implementation. At this stage, the analysis of costs and benefits has been done at a general level as part of the STAPLEE methodology. However, as project funding becomes available, the county and municipalities will undertake a more extensive process.

Benefit-cost analysis (BCA) compares the benefits of mitigation measures to the costs, and is a technique used for evaluating the cost-effectiveness of mitigation measures. FEMA requires a BCA for all mitigation projects that receive FEMA funding.

The Middlesex HMSC discussed the potential costs associated with each type of mitigation measure and decided that any project could be cost effective if its scope were properly tailored to the situation. For example, one of the most effective mitigation measures identified for repetitively flooded structures is elevation.

It may not be cost effective to elevate every single repetitively flooded structure in the County, but it certainly would be cost effective to elevate those that cause the largest drain to the National Flood Insurance Program (NFIP).

After discussing the possible costs of the various mitigation measures, the Middlesex HMSC decided that instead of working on developing a very generic BCA at this time for projects that may not ever be authorized, they would wait until specific funding sources are identified and available. For example, most municipalities are not financially capable of elevating or acquiring any repetitively flooded structures without Federal Grant assistance. However, at the time that grants become available [Hazard Mitigation Grant Program (HMGP) after disasters or Pre-Disaster Mitigation (PDM) and Flood Mitigation Assistance (FMA) grants annually], the County will collect detailed information on each structure that is interested in participating in the grant program and perform a BCA to help rank the structures as part of the STAPLEE process to determine which should receive funding first.

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Section 10
Plan Monitoring and Maintenance

Contents of this Section

10.1 IFR Requirement for Plan Monitoring and Maintenance

Requirement §201.6(c)(4)(i): *[The plan maintenance process* ***shall*** *include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle*

Requirement §201.6(c)(4)(ii): *[The plan* ***shall*** *include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.*

Requirement §201.6(c)(4)(iii): *[The plan maintenance process* ***shall*** *include a] discussion on how the community will continue public participation in the plan maintenance process.*

10.2 Method for Monitoring the Plan

This Plan will be monitored by the Middlesex County Office of Emergency Management (MC OEM) for several related purposes:

- Maintain the currency of hazard and risk information.
- Ensure that mitigation projects and actions reflect the priorities of Middlesex County and stakeholders.
- To comply with FEMA and the State of New Jersey requirements for plan maintenance and maintain Middlesex County's eligibility for federal disaster assistance and mitigation grants.

The MC OEM will monitor the plan with respect to the purposes noted above, according to the schedule described in Section 10.3 and with respect to the update triggers noted in Section 10.5 below.

Specifically, monitoring activities will consist of:

- Soliciting and reviewing reports from participating municipalities regarding status of implementation of action items from the Plan. Status reports will indicate if projects have been:
  - Scoped and/or documented for FEMA grant applications;
  - Submitted for FEMA funding programs;
  - Approved (or denied approval) for FEMA funding;
  - Documented for funding by other means (e.g., municipal capital improvement plans);
  - Funded (or not approved for funding) by other means;
  - Under construction;
  - Completed; and
  - (for completed projects only) Subject to hazard conditions such that avoided losses can be documented.
- Tracking progress of sources of improved or revised data for use in subsequent Plan updates on an annual (at a minimum) basis.
- Preparing a report of the status of implementation of action items from the Plan and the availability of improved or revised data. The report will include recommendations to the Hazard Mitigation Working Group regarding the need and/or advantages of undertaking updates to all or part of the Plan prior to the five-year required update (see Section 10.4).

10.3 Schedule for Monitoring the Plan

Informal Plan monitoring activities will be ongoing. In addition to the FEMA mandated five year update cycle, the Middlesex County Emergency Management Coordinator or his designee (Coordinator) will perform monitoring activities for the Plan as described in Section 10.2
every six months, or more often as circumstances require.

In addition to the scheduled reports, the Coordinator will convene meetings after damage-causing natural hazard events to review the effects of such events. Based on those effects, adjustments to the mitigation priorities identified in Section 9 may be made or additional event-specific actions identified.

10.4 Method and Schedule for Evaluating and Updating the Plan

Comprehensive evaluation of and updates to this Plan will be undertaken on a five-year cycle (at a minimum). This Plan was adopted on October 21, 2010 and thus must undergo a formal FEMA-compliant update process by October 21, 2015. Approximately one year prior to the five year anniversary of Plan adoption or sooner if circumstances require, the Coordinator will initiate a comprehensive evaluation of the Plan with particular attention to FEMA guidance.

The criteria to be used in this evaluation include (but are not limited to) the following:

- Assessing whether or not goals and objectives in the Plan address current and expected conditions;
- Determining if there are any changes in risk factors and/or data that would be relevant to hazards in Middlesex County;
- Determining if capabilities have changed relative to the County and municipalities' ability to plan and implement hazard mitigation projects;

- Determining if significant changes have occurred in the availability of funding at federal and state levels to support hazard mitigation planning and implemention; and
- Results in implementing the Plan per monitoring reports (per Sections 10.2 and 10.3).

The Coordinator will prepare a report (1) describing the update requirements; (2) summarizing the staff evaluation of the Plan, highlighting areas that require updating and explaining the reasons why the updates are needed, and; (3) providing detailed recommendations about how the Plan should be updated, noting any technical work that may be required.

For example, as noted above in previous sections of the Plan, Middlesex County is due to receive updated DFIRM floodplain mapping for the entire county in 2009. This new mapping will be the basis for an improved flood risk assessment in the next Plan update and would be one of the reasons cited for why the modification is needed.

The report will sequentially be provided to the Middlesex County Hazard Mitigation Steering Committee (HMSC) and Middlesex County Board of Chosen Freeholders for consideration. The report will also be posted on the MC OEM website for public review and comment.

The HMSC and the Board of Chosen Freeholders will review the report and recommendations and advise the Coordinator how to proceed on the individual recommendations for the updates. The Coordinator will initiate activities to carry out the recommendations, and will prepare draft updates to the Plan on a schedule determined in cooperation with the HMSC and Board of Chosen Freeholders

When the draft updates are completed, the HMSC will be convened to conduct the comprehensive evaluation and revision. The HMSC (with input from the Local Coordinators) and Coordinator will produce a final draft of the updated Plan for consideration by the Board. The Board will review the updated Plan, indicate any desired changes, approve and adopt the Plan in sufficient time to meet FEMA requirements.

10.5 Circumstances that will Initiate Plan Review and Updates

This section identifies the circumstances or conditions under which MC OEM will initiate Plan reviews and updates.

- On the recommendation of the Coordinator or on its own initiative, the Middlesex County Board of Chosen Freeholders may initiate a Plan review at any time.
- At approximately the one-year anniversary of the initial Plan adoption, and every year thereafter.
- After natural hazard events that appear to significantly change the apparent risk to Middlesex County assets, operations and/or constituents.

10.6 Other Local Planning Mechanisms

It should be noted that Middlesex County has limited land use planning and zoning authority, so the County has few opportunities to incorporate this Plan into other local mechanisms, such as zoning and subdivision ordinances, or comprehensive land use plans. This plan will be incorporated, to the extent possible, into the County Open Space Master Plan and the County Capital Improvement Plan. In addition, MC OEM will work with individual municipalities to incorporate the recommendations of the Plan into local comprehensive planning and capital improvement programs.

Participating municipalities in this Plan will work to incorporate the goals of this Plan into the next update of relevant plans and regulations, including comprehensive plans, zoning codes, and capital improvement plans. Table 10.6-1 shows dates of upcoming municipal updates to these plans and documents. It should be noted that counties and municipalities are not empowered to make alterations or improvements to the state's building code, the Uniform Construction Code.

Table 10.6-1
Scheduled Updates to Relevant Plans and Documents

Plan or Document	Next Update
Carteret Master Plan	2010
Carteret Zoning	2010
Carteret CIP	Annually
Cranbury Master Plan	2011
Cranbury Zoning	Not scheduled
Cranbury CIP	Annually
Dunellen Master Plan	2009
Dunellen Zoning	2009
Dunellen CIP	Annually
East Brunswick Master Plan	Not scheduled
East Brunswick Zoning	Annually
East Brunswick CIP	Annually
Edison Master Plan	2013
Edison Zoning	2010
Edison CIP	Annually
Helmetta Master Plan	2013
Helmetta Zoning	Not scheduled
Helmetta CIP	Annually
Highland Park Master Plan	2010
Highland Park Zoning	2010
Highland Park CIP	Annually
Jamesburg Master Plan	2010
Jamesburg Zoning	2010
Jamesburg CIP	Annually
Old Bridge Master Plan	2010
Old Bridge Zoning	Not scheduled
Old Bridge CIP	Annually
Metuchen Master Plan	2012
Metuchen Zoning	2012
Metuchen CIP	Annually
Middlesex Master Plan	2009
Middlesex Zoning	As needed
Middlesex CIP	Annually
Milltown Master Plan	2010
Milltown Zoning	2010
Milltown CIP	Annually
Monroe Master Plan	2010
Monroe Zoning	2010
Monroe CIP	Annually

Plan or Document	Next Update
New Brunswick City Master Plan	2010
New Brunswick City Zoning New	Not scheduled
Brunswick City CIP	Annually
North Brunswick City Master Plan	2011
North Brunswick City Zoning	2011
North Brunswick City CIP	Annually
Perth Amboy Master Plan	2015
Perth Amboy Zoning	2011
Perth Amboy CIP	Annually
Piscataway Master Plan	2011
Piscataway Zoning	2010
Piscataway CIP	Annually
Plainsboro Master Plan	2010
Plainsboro Zoning	2013
Plainsboro CIP	Annually
Sayreville Master Plan	2010
Sayreville Zoning	2010
Sayreville CIP	Annually
South Amboy Master Plan	2009
South Amboy Zoning	2009
South Amboy CIP	Annually
South Brunswick Master Plan	2013
South Brunswick Zoning	Updated with every land use ordinance
South Brunswick CIP	Annually
South Plainfield Master Plan	2012
South Plainfield Zoning	2010
South Plainfield CIP	Annually
South River Master Plan	2009
South River Zoning	2009
South River CIP	Annually
Spotswood Master Plan	2010
Spotswood Zoning	2010
Spotswood CIP	Annually
Woodbridge Master Plan	2011
Woodbridge Zoning	2011
Woodbridge CIP	Annually

10.7 Continued Public Involvement

As noted above, this Plan will be evaluated and updated periodically and when certain triggering events occur. Middlesex County will utilize public notices and a centralized website in an effort to include the public in the update process. In addition, MC OEM will undertake public outreach and awareness activities as outlined in the Mitigation Action Plan that will include continuing updates on the progress of implementing the Plan and future updates.

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